PANTHER™

Installer's Handbook

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INSTALLER'S HANDBOOK

FIRST EDITION

MAY 15, 1987

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USA: FCC Radio Regulatory Approval, Report and Order in GEN Docket 82-827, FCC 84-406 (August 27, 1984).
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Using This Handbook

Before You Start

How to Use This Handbook

Related Panther Publications

Before You Start

You should read this book if you are:

- an installer
- a system designer

What is Panther?

Panther is the most advanced outdoor intrusion detection system available. It uses buried sensor cables and radar-like detection to provide intelligent perimeter protection. It detects human intruders silently and invisibly while ignoring birds, small animals and other disturbances which can cause nuisance alarms in other systems.

Panther's buried sensor cables can be hidden in earth, concrete or asphalt to protect up to 1000 ft (300 m) of perimeter. Intruders are detected the instant they cross the cables.

Panther can be used as a stand-alone system or in conjunction with other alarm systems such as contact closures, microwave motion detectors, and so on.

This book will make your job easier to do. It tells you how to:

- lower the cost of installation
- reduce installation time
- have trouble-free installations
- eliminate call backs

It is assumed you are an experienced alarm system designer or installer. If you would like a non-technical explanation of the Panther, consult the list of related publications provided in this section.

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Metric Conversion Rules

- all linear measurements are given using the metric system
- equivalent foot and inch measurements are provided
- the conversion factor used is 3.2808 feet per meter
- conversions for lengths greater than 10 m are rounded to the nearest foot
- conversions for lengths less than 10 m are rounded to the nearest inch
- fractional inch measurements are expressed in decimal form

NOTE: Where doubt exists about the accuracy of a conversion, the metric measurement should be taken as correct.

For convenience, measurements relating to the spacing between sensor cables have been expressed as multiples of the basic 1 m (3 ft, 3 in) spacing:

- 1 m = 3 ft, 3 in
- 2 m = 6 ft, 6 in
- 3 m = 9 ft, 9 in

How to Use This Handbook

This handbook contains a Reader's Road Map which tells you what to read when you need to "brush up" on your knowledge of Panther. The road map is helpful when you're:

- going through the first time
- getting ready to do an installation
- doing an installation
- commissioning the system
- in need of a quick review

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Installer's Checklist

A comprehensive installation checklist is included at the back of this book. As you become more experienced at installing Panther, you will find the checklist is all you need to install trouble-free systems. Each item on the checklist has a page number which tells you where the item is discussed in this book.

If you're looking for specific information, the Table of Contents at the front of this handbook will help you find what you're looking for. If you come across terms you're unfamiliar with, consult the Glossary at the back of this handbook.

What This Handbook Describes

Using This Handbook:

- the section you're reading right now
- how this guide is organized
- conversion rules
- maps of routes you can follow through the guide

How Panther Works:

- an overview of Panther operation
- operation of the detection unit
- how the sensor cables work
- perimeters, zones and loops

Getting Ready:

- how to check system design
- guiding principles for system design and installation
- parts you will need
- tools and materials you will need

Making Connections and Splices:

- connector installation
- terminator and decoupler installation
- cable splicing and repair techniques

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Installing the Cables:

- site preparation
- marking cable routes
- avoiding obstacles
- bypassing problem areas
- preparing cables
- cutting cable channels
- running lead-in cable indoors

Installing the Detection Unit:

- mounting
- connections to external devices
- installing supervision resistors
- using the option selection switch

Commissioning

- setting up equipment
- setting sensitivity
- how to improve sensitivity
- customer acceptance testing

Sample Installations

- case studies based on actual Panther installations
- sample site plans and completed checklists
- order of events during installations

Installer's Checklist

- step-by-step instructions
- brief reminders of standard procedures and techniques

Glossary

- a glossary of terms

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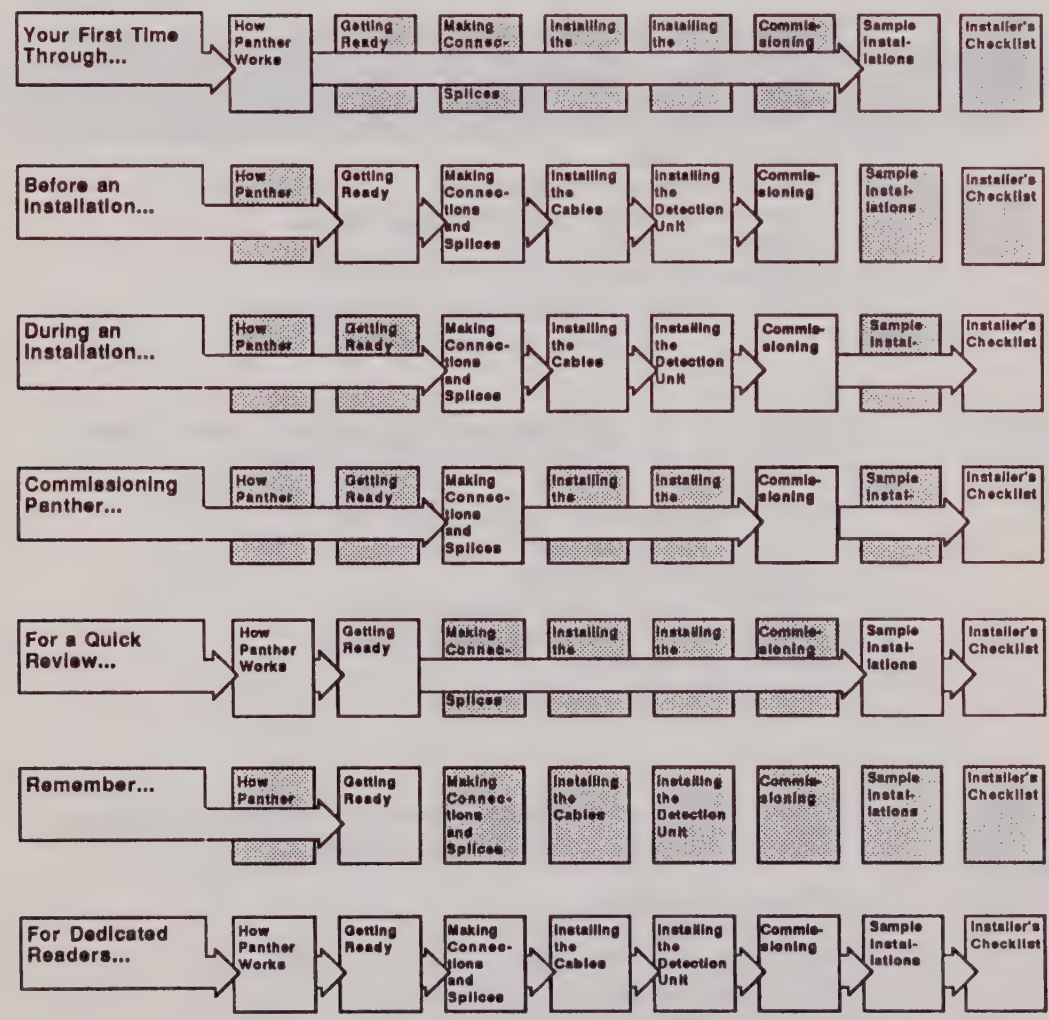
Panther Installer's Handbook
Reader's "Road Map"



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Related Panther Publications

Panther Application Guide

Written for the salesperson and system designer, the Application Guide contains information about:

- how Panther works
- Panther's features
- identifying potential customers
- rules for designing trouble-free installations
- sample applications
- planning a customer's site
- how to prepare a customer quote and order parts

Panther Owner's Guide

Written for the end user and shipped with every Panther detection unit, the Owner's Guide tells the user about:

- how Panther works
- how alarm systems work
- Panther's special features
- what the controls and indicators are for
- how to test and adjust Panther's operation
- routine maintenance
- a few troubleshooting techniques

Panther Technical Reference Manual

Written for the technologist/engineer, the Technical Reference Manual provides technical information about:

- Panther's equpiment
- theory of operation
- troubleshooting flowcharts
- servicing procedures
- schematics and circuit diagrams
- spare parts list
- assembly drawings

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How Panther Works

General Theory

The Detection Unit

The Sensor Cables

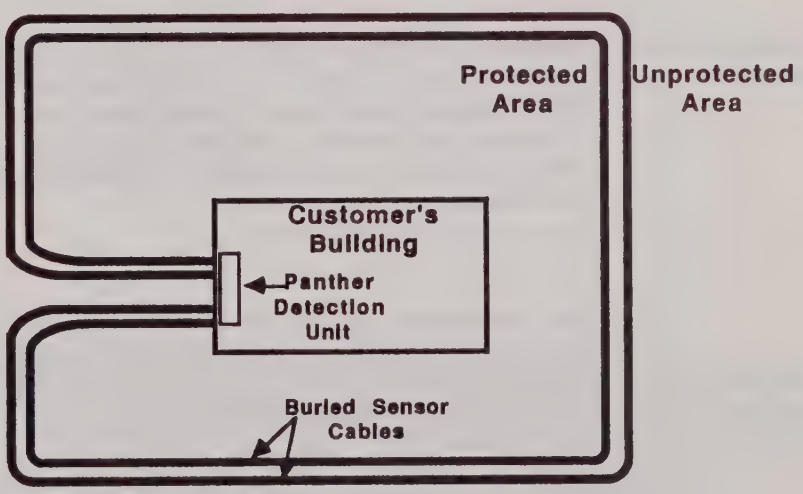
Zones and Site Coverage

General Theory

It helps to know some of the theory behind Panther before you design a comprehensive alarm system for your customer.

The Detection Unit

In a typical Panther installation, the Panther detection unit is mounted inside a building on the customer's site. The detection unit is connected to sensor cables buried around the perimeter of the site. An example is shown below. Panther detects any intruder crossing over the cables and signals an alarm.



NOTE: Details have been simplified

Special Sensor Cables

The key to this system is the buried sensor cables. The cables are special coaxial cables often referred to as "ported" or "leaky" cables. This means that radio-frequency signals passing through the cables are emitted into the environment. Conversely, radio-frequency signals in the environment can also be detected by these kinds of cables.

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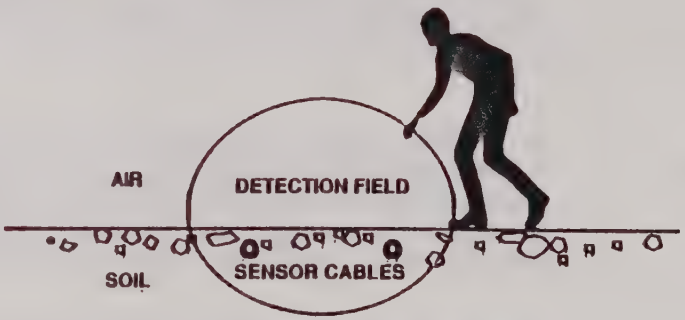
In the Panther system, one cable transmits a radio-frequency signal and the other cable (which runs parallel to the transmitting cable) receives the signal. Any intruder crossing the cables disturbs the signal being received. A microprocessor analyzes the signal to determine if there is an intruder in the detection field.

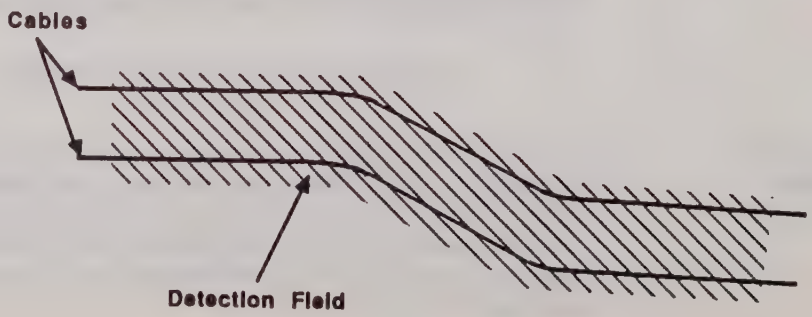


Intelligent Detection

Panther's microprocessor uses an adaptive detection methodology; in other words, Panther adjusts itself to changing environmental conditions. Panther provides optimum detection of adult-sized intruders while rejecting false alarms caused by small animals, birds, debris, or other disturbances in the environment.

Computer Controlled "Radar"

The process used by Panther is very similar to radar, but there is one important difference: the Panther detection field follows the sensor cables and can be guided around corners and up and down hills. This means Panther isn't restricted to line-of-sight applications.



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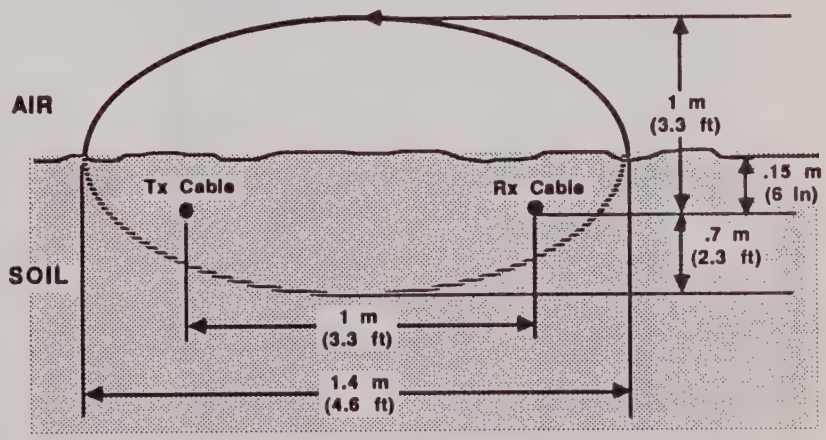
Detection Field Shape

The detection field is the area in which Panther can detect a target. The transmitting cable radiates its signals in all directions, and the receiving cable is omnidirectional as well. This results in a detection field that is roughly oval in cross section surrounding both cables.

Panther's detection field is disturbed by any object that has a large enough "electromagnetic cross section". Metallic and water-filled objects (such as human beings) have large electromagnetic cross sections and therefore cause a large disturbance of the field. Wooden and plastic objects do not cause a significant disturbance. The size of the detection field varies depending on the size of the object near the detection field. A truck has a larger detection field than a human being, for example.

When a human being crosses the cables, the detection field will be approximately:

- 1 m (3 ft, 3 in) high
- 1.4 m (4 ft, 7 in) wide



These dimensions are typical for sensor cables buried in soil and spaced 1 m (3 ft, 3 in) apart.

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The field also extends about 0.7 m (2 ft, 4 in) below the cables in the ground, allowing Panther to detect tunnelling attempts.

The field is not full-sized in the 4 m (13 ft) field start section or at the end of the sensor cables past the terminators or decouplers.

You can completely compensate for partial detection in the field-start section by overlapping the field-start sections in the perimeter. See the Installing Sensor Cables section for more information.

Consult the Using this Handbook section for the names of related publications containing more technical details if you need them.

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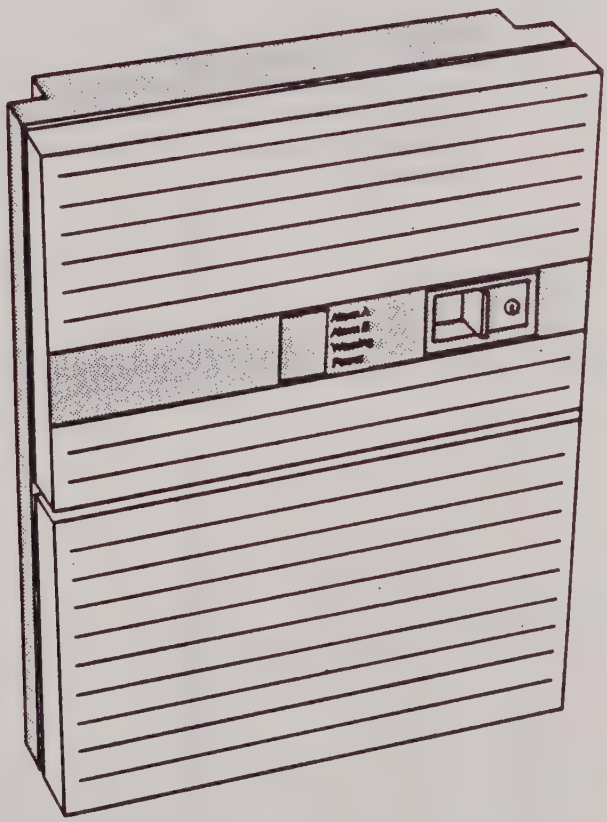
The Detection Unit

The detection unit is an attractively-styled, wall-mounted enclosure. It contains the microprocessor electronics and provides connections to the sensor cables and other sensors.

What it Looks Like



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What it Does

The detection unit sends a radio-frequency signal down one cable. This signal creates a detection field which is received by the second cable and sent back to the detection unit. The detection unit microprocessor analyzes the received signal and looks for any disturbances in the detection field caused by an intruder. When an intruder is detected, the detection unit instantly indicates an alarm condition.

Disturbances in the detection field are analyzed by an on-board microprocessor and related software. The microprocessor is programmed to ignore background noise and categorize the disturbances by size; larger targets generate larger disturbances. This is how Panther differentiates between humans and small animals. When you set the sensitivity on Panther, you are telling the microprocessor what size of disturbance is considered an intruder.

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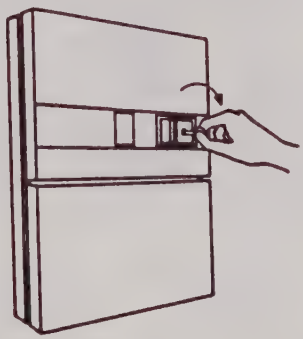
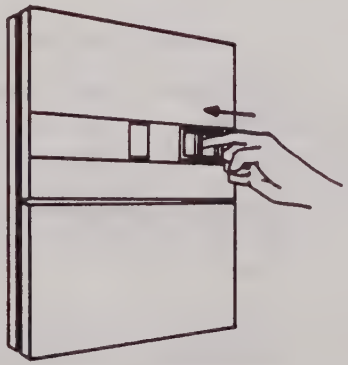
Accessing the Controls

The detection unit controls are securely hidden behind the top door of the detection unit. The four indicator lights are visible through a window in the top door. To access the detection unit controls:

1. Unlock the top door by inserting the key and turning it clockwise. The key can be removed after turning it.



2. Unlatch the door by sliding the latch to the left. Swing the door open.



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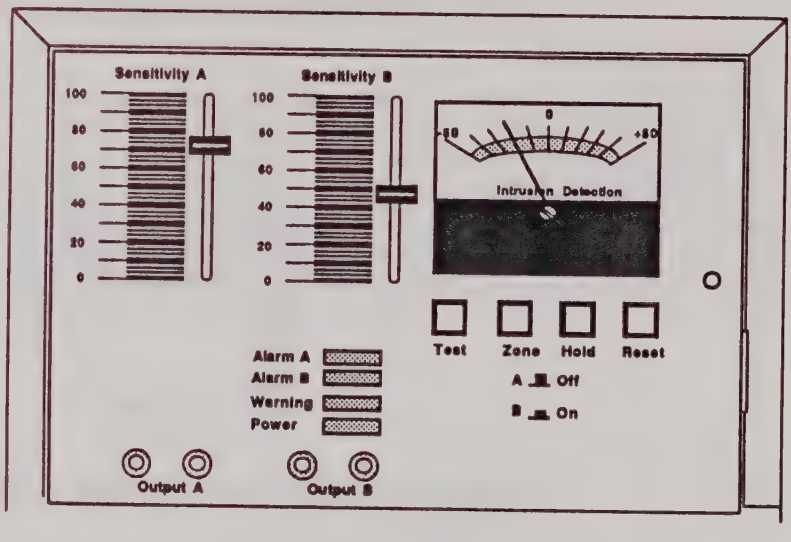
The Controls

The detection unit controls are designed to make it easy for the installer to set up Panther. The controls and indicators are shown below.



The purpose of each detection unit control and indicator is listed below.

- **Sensitivity A and B** - let you make the detection field more or less sensitive to intruders. There is one control for each zone.

- **Intrusion Detection Meter** - indicates intrusions in the zone selected by the Zone switch.

- **Test** - when this switch is pressed, Panther initiates a system test.

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- **Zone A or B** - lets you select which zone is being monitored by the detection meter. When this switch is locked in the "B", position, the detection meter monitors zone B. When this switch is locked in the "A", position, the meter monitors zone A.

- **Hold** - when this switch is locked in the "On", position, the detection meter holds its highest reading. When this switch is in the "Off" position, the detection meter operates normally.

- **Reset** - when this switch is pressed, Panther returns to its normal state and accepts all objects currently in the detection field as objects that belong there. After you press Reset, any movement in the detection field causes an alarm.

- **Alarm A and B** - glow red when an intruder enters corresponding zone.

- **Warning** - glows yellow when Panther's door is opened or an equipment fault is detected.

- **Power** - glows green when the power is on.

- **Output A and B** - allow you to obtain analog signals used for commissioning the system. You can connect a chart recorder to these jacks and monitor the sensitivity levels in each zone. See the Commissioning section for more information.

- **Tamper** (inside hole) - switch that is activated when Panther's door is opened.

For more information about how to use the detection unit controls, see the Installing the Detection Unit section and the Commissioning section.

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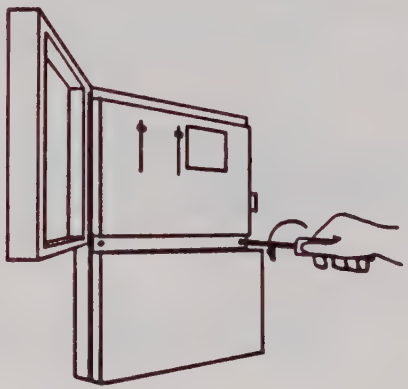
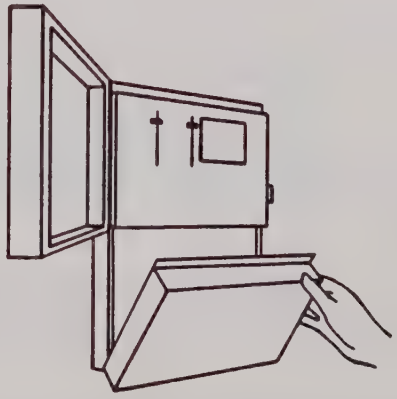
Accessing the Connectors

The bottom door of the detection unit covers the connectors for the sensor cables. It also covers a terminal strip that allows connection to other equipment such as an alarm panel. To open the bottom door:

1. Use a standard screwdriver or small coin to turn the screws at the top of the door 1/4 turn counter clockwise.



2. Swing the door downwards.



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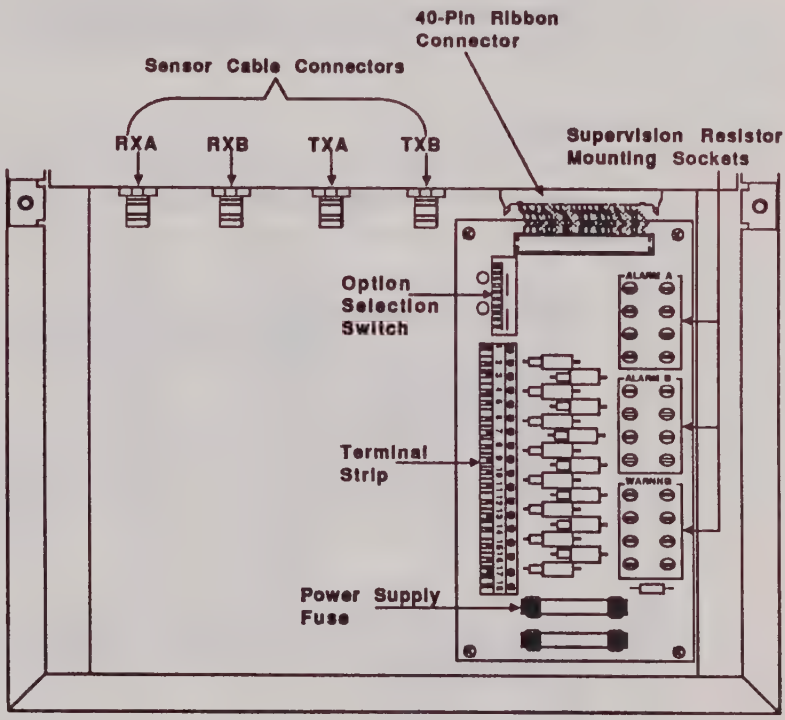
The components located in the bottom half of the detection unit are shown below.



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Each component in the bottom of the detection unit is described below.

- **RXA, RXB, TXA, TXB** - connections to the sensor cables. There is one transmit (Tx) and one recieve (Rx) connector for each zone.

- **Terminal Strip** - an eighteen-position terminal strip containing: form C relay outputs for connection to an alarm panel or other device, inputs for 12 Vdc, and inputs for remote control.

- **Supervision Resistor Mounting Sockets** - for alarm panels requiring supervision (end-of-line) resistors.

- **Option Selection Switch** - allows you to select the type of analog signal emitted from the Output A and B jacks on the front panel. Also allows the installer to combine warning alarms with intrusion alarms and disable the tamper switch.

- **Power Supply Fuse** - easily replacable 3/4 A fast blow 3AG type fuse. A spare fuse is provided on the terminal connection module.

For more information about how to use the connectors found at the bottom of the detection unit, see the Installing the Detection Unit section and the Commissioning section.

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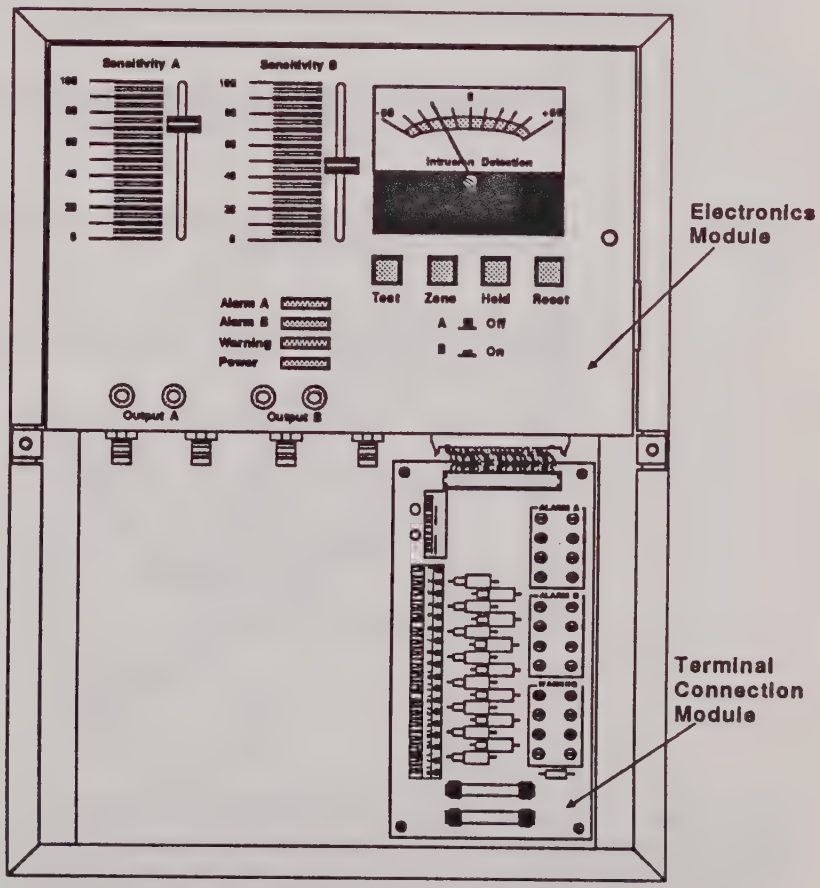
Modular Design

Panther's detection unit is designed in a way that allows you to easily remove and replace the two major electronic components located inside the metal housing. The two components are:

- the electronics module
- the terminal connection module



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Procedures for removing and replacing these two modules are given below.

Removing the Electronics Module

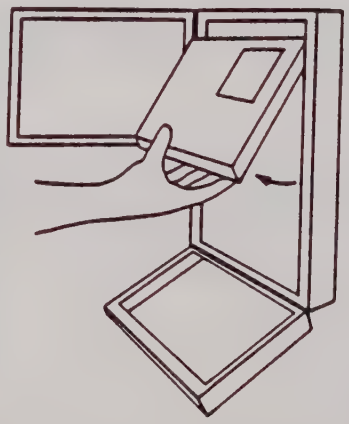
The electronics module is located behind the top door. It contains Panther's controls and indicators and all of the detection electonics. The electronics module can be easily removed by following the procedure given below.

1. Disconnect the power. Disconnect the sensor cables and the ribbon cable from the electronics module.

2. Place your hand underneath the TX and RX connectors and grasp the bottom of the electronics module.

3. Unsnap the bottom of the detection electronics module from the housing by pulling firmly.

4. Swing the electronics module out and downward to remove it from the housing.



To replace the electronics module, simply snap the module back into position and re-attach the sensor cables and ribbon cable.

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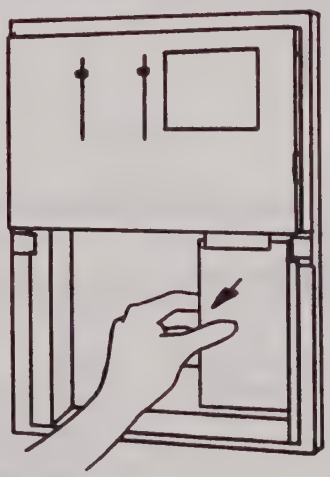
Removing the Terminal Connection Module

The terminal connection module is located behind the bottom door. It contains the option selection DIP switch and the 18-position terminal strip. You can remove the terminal connection module by following the simple procedure given below.

1. Disconnect the power and all other connections to the 18-position terminal strip. Label the wires prior to removal to simplify re-connection. Undo the retaining clips and disconnect the ribbon cable from the electronics module.

2. Grasp the terminal connection module with one hand.

3. Pull firmly to unsnap the module from the four standoffs attached to the housing.



To replace the terminal connection module, make sure the ribbon cable connector is at the top, and then snap the module back into position on the four standoffs. Re-attach the ribbon cable. Re-attach all of the connections to the 18 position terminal strip.

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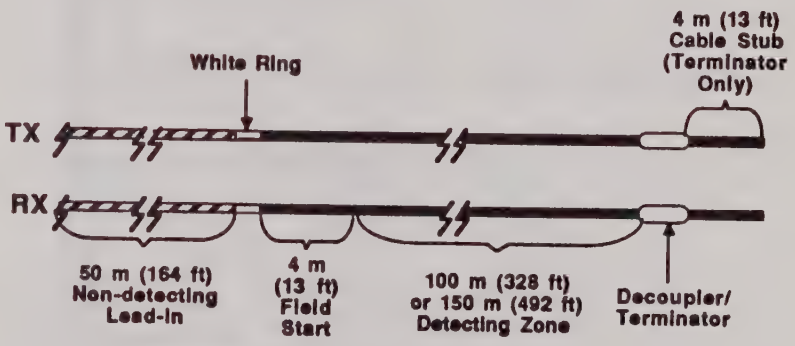
The Sensor Cables

At first glance, the sensor cables appear to be the same as those used for cable TV wiring. However, each sensor cable has a patented interior construction designed exclusively to work with the Panther alarm electronics. The proprietary design minimizes the number of connections required during installation.

The sensor cables have three different sections:

- a 50 m (164 ft) non-detecting or lead-in cable section
- a 4 m (13ft) field start section which has partial detection
- a detecting section which is available in 100 m (328 ft) or 150 m (492 ft) lengths



There are no physical differences between transmit and receive sensor cables.

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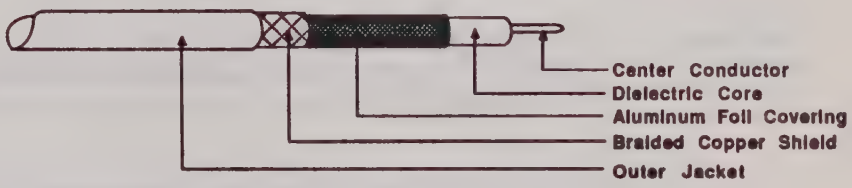
Non-Detecting Section

The first 50 m (164 ft) of each sensor cable is a non-detecting lead-in section. It's constructed like standard coaxial cable with:

- a centre conductor
- surrounding dielectric
- an aluminum foil covering
- a braided shield,
- an outer jacket

This section of the sensor cable carries the rf signals between the protected zone and the detection unit.



Detecting Section

The remainder of the sensor cable is definitely not standard. It has:

- a centre conductor
- surrounding dielectric
- no aluminum foil covering
- a "ported" braided shield
- an outer jacket

The shield in the detecting section of the cable is "ported" with diamond-shaped openings and the foil covering is absent, allowing the rf signals to leak out. This is, of course, the desired effect. The design allows the rf to radiate from the transmitting cable and be detected on the receiving cable, which acts like an antenna.

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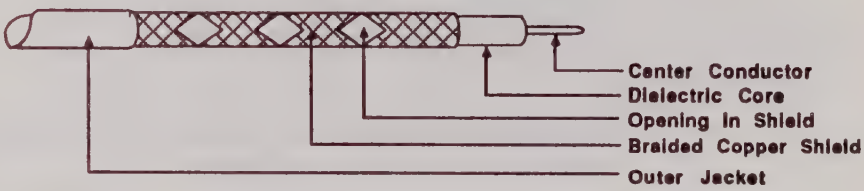
To compensate for losses in the cable, the holes in the shield increase in size as you move away from the non-detecting end. This "grading" of the openings ensures that the detection field will be uniform along the length of the sensor cable.



Field Start Section

The first 4 m (13 ft) of the ported section is the "field-start" section. This is the section of the cable where the rf detection field first forms.

Because the detection field is building up to full size in the field-start section, intruders may not be detected in this section. To compensate for the reduced sensitivity, the field-start sections of two zones are overlapped to provide full coverage and to prevent a "low spot" in the detection perimeter. For more information about installing overlaps, see the Installing the Sensor Cables section.

Ferrite Beads

To prevent the detection field from straying backwards towards the detection unit, ferrite beads are placed on the non-detecting lead-in cable adjacent to the field-start section.

Cable Lengths

References to cable lengths are always given for the detecting section only, unless stated otherwise. The detecting section is available in lengths of 100 m and 150 m (328 ft and 492 ft). An extra 4 m (13 ft) of ported cable is supplied to allow for the field-start section. The non-detecting section is only supplied in 50 m (164 ft) lengths.

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Although the cables are supplied in standard lengths, they can be cut to any length to suit the requirements of the site.

A 100 m (328 ft) cable has:

- a non-detecting section 50 m (164 ft) long
- a field-start section 4 m (13 ft) long
- a detecting section 100 m (328 ft) long

The total physical length of this cable is 154 m (505 ft).

A 150 m (492 ft) cable has:

- a non-detecting section 50 m (164 ft) long
- a field-start section 4 m (13 ft) long
- a detecting section 150 m (492 ft) long

The total physical length of this cable is 204 m (669 ft).

Cable Markings

The point on the sensor cable where the non-detecting section joins the ported detecting section is marked by a white ring. This ring is also sometimes referred to as the "white mark" or the "white dot".

Cable Packaging

Sensor cables are shipped from the factory in sets of two. Each of the sensor cables is coiled inside a specially designed cardboard "cable caddy". The cable is dispensed through a hole on the side of the cable caddy. The first 50 m (164 ft) of cable that comes out of the dispenser is non-detecting cable.

You can use either of the cables in the set as transmitter or receiver. There are no physical differences between transmit and receive sensor cables.

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Zones and Site Coverage

A zone is a section of the protected perimeter.

Panther can monitor one or two zones, called zone A and zone B. Each zone can have a length of up to 150 m (492 ft). The total monitored perimeter can be up to 300 m (984 ft) long.

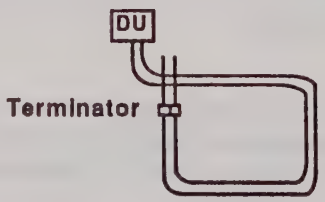
Closed Loop

The monitored perimeter is usually a closed loop that surrounds the area to be protected. Since Panther can monitor two zones, it can protect two different areas with closed loops.

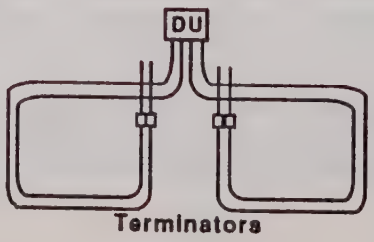
In closed loop configurations, the cables cross over themselves to form an enclosed area. Closed loops are used on sites where a perimeter is small enough to be covered by one zone, or where two small perimeters are required.

Terminators are attached to the sensor cables at the end of each zone to stop the detection field.

Single Zone, Closed Loop



Two Zones, Closed Loop



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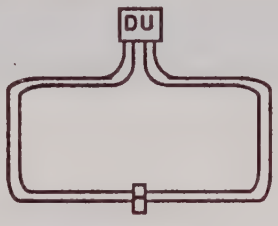
Two Zone, Decoupled Loop

Long perimeters can be surrounded by joining the ends of the sensor cables in zone A to the ends of the sensor cables in zone B. Devices called decouplers are used to join the ends of the sensor cables together. The decoupler stops the detection field at the end of each zone. This type of closed loop is called a Two Zone, Decoupled system.

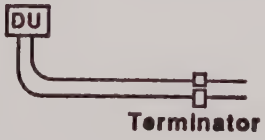


Open Loop

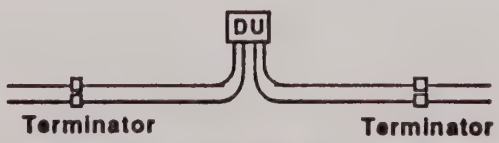
Open loops are used on sites where the protected area doesn't need to be surrounded. In an open loop configuration, the sensor cables aren't crossed or joined.

The sensor cables are placed in a partial loop around the site, protecting the most vulnerable approach path. The two zones can even be used to protect two different areas. In order to stop the detection field, terminators are attached to the sensor cables at the end of each zone.

Single Zone, Open Loop



Two Zones, Open Loop



For applications that require more than two zones or have a perimeter length greater than 300 m (984 ft), contact your Panther distributor for information.

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Getting Ready

Trouble-Free Installations

The Six Steps to Success

Checking the Site Plan

Parts You Will Need

Tools and Materials You Will Need

Trouble-Free Installations

The Golden Rule: Make Good Connections

As an Installer, your major concern is that all sensor cable connectors and terminators/decouplers are installed correctly. THIS CAN NOT BE OVER EMPHASIZED. System reliability depends directly on good sensor cable connections. Most problems can be traced to poorly installed connectors. Avoid call-backs! Follow the recommended procedures.

Detailed procedures for installing connectors, terminators and decouplers are included in the Making Connections and Splices section of this handbook. Read that section before you install your first system and make sure you practice the procedures. Bring this handbook with you when you install a system so that you can refer to the procedures during installation if necessary.

Guiding Principles

All trouble-free Panther systems have two things in common: proper design and correctly installed sensor cables. Customer satisfaction requires well designed cable routing and adherance to six simple rules. These Six Steps to Success will:

- reduce installation time
- reduce the cost of installation
- ensure the system works well

The Six Steps to Success are:

1. Measure Carefully
2. Bury in a Single Medium (Soil if Possible)
3. Bury at Proper Depth
4. Keep Cable Spacing Constant
5. Make Gradual Turns
6. Avoid Obstructions

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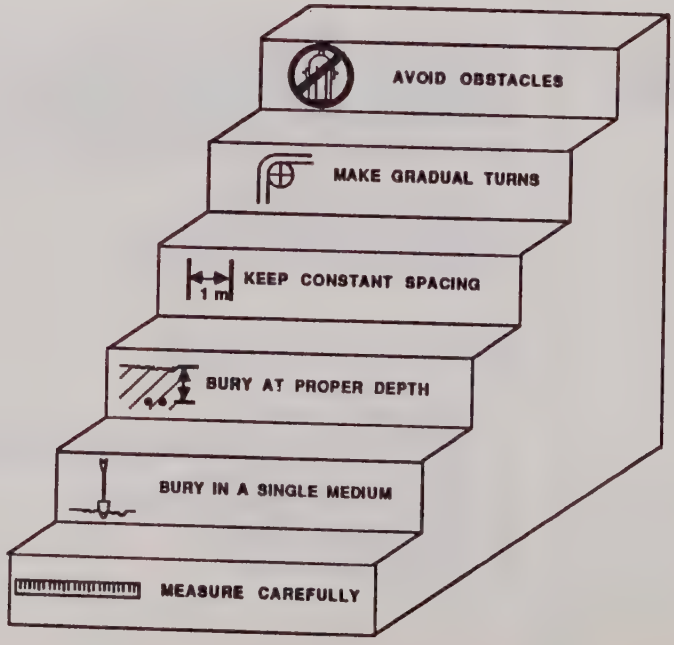
The Six Steps to Success can be summarized into one guiding principle:

- Keep zones uniform.

Within each zone there are many variables: burial depth, medium, spacing, and so on. Although Panther is adaptable enough to use in almost any situation, there are limits beyond which the performance begins to degrade. The Six Steps to Success represent the most critical aspects for good performance. If you follow the Six Steps, you shouldn't encounter problems.

The site plan designer used the Six Steps to Success to lay out the sensor cable route and decide where to place the terminators or decouplers. You should review the steps in order to understand some of the design decisions.



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The Six Steps to Success

1. Measure Carefully

The measurements taken during the site survey have been used to estimate the materials and labor required to do the installation. Careful measurements are necessary if you're to have the correct quantities on hand during installation. Where outside contractors are going to perform some of the work, such as cable burial, they will use your measurements to provide an estimate.

2. Bury in a Single Medium

Burial in soil is both the easiest and least expensive method of installing sensor cables. Where possible, route the cables so they are in soil. If it's necessary to bury the sensor cables in more than one medium, try to keep each zone in a single medium. This allows you to optimize the sensitivity of each zone for each burial medium.

As an example, consider a site with a 200 m (656 ft) perimeter consisting of:

- 150 m (492 ft) of soil
- 50 m (164 ft) of asphalt

The temptation is to use two 100 m (328 ft) zones. This will make one zone straddle two different media. To avoid this problem:

- Make one zone 150 m (492 ft) long (in the soil).
- Make the other zone 50 m (164 ft) long (in the asphalt).
- Put the decouplers at the soil/asphalt boundary.

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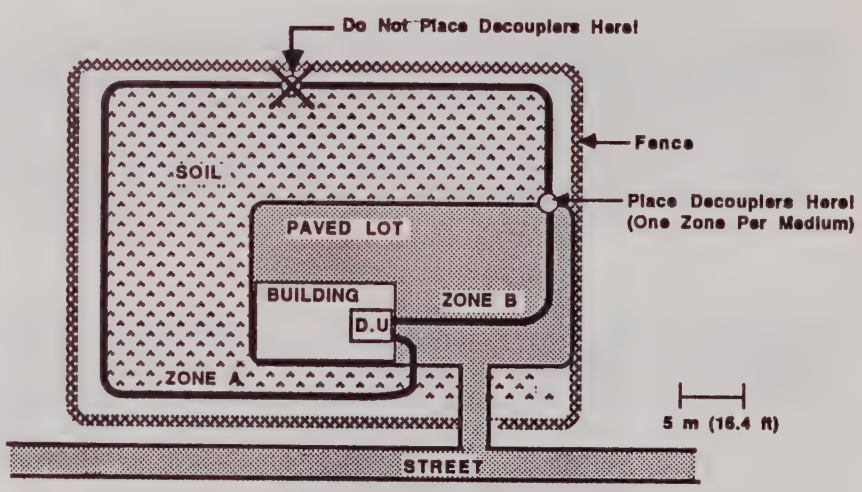
In some cases it may not be possible to have each zone in a single medium. If you must have a zone cross two (or more) media, follow the rules in the next step to help compensate for the changes in sensitivity.



3. Bury at Proper Depth

The recommended burial depth depends on the medium:

- soil: 15 cm (6 in)
- asphalt: 2.5 cm (1 in) -or- 23 cm (9 in)
- concrete: 2.5 cm (1 in) -or- 23 cm (9 in)

Note that two depths are used for asphalt and concrete:

- 2.5 cm (1 in) when the sensor cables are placed in slots cut in the pavement surface
- 23 cm (9 in) when the sensor cables are placed in the soil below the pavement

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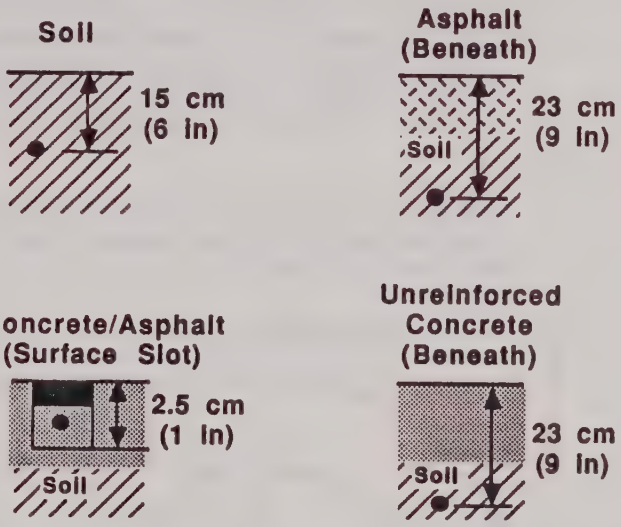
Panther's sensitivity is higher where the sensor cables are buried in or under asphalt or concrete. To compensate for this effect, you can bury the cables deeper in these media. The burial depth must change at the transition from one medium to another. The least desirable transition is from a slot cut in pavement to any other medium. Avoid such transitions within one zone by placing the decouplers here.



4. Keep Cable Spacing Constant

The two sensor cables run parallel to each other around the protected perimeter. The cables must be at least 1 m (3 ft, 3 in) apart at all points, including curves. Altering the spacing can adversely affect the sensitivity.

Wider cable spacing is permitted for parking lot applications where vehicles are parked directly over the cables. The cables can be either:

- 2 m (6 ft, 6 in) apart (one row of cars)
- 3 m (9 ft, 9 in) apart (two rows of cars or tractor trailers)

You can use the spacing which provides the best coverage. Spacing must be constant within one zone, but two zones can have different spacings if required.

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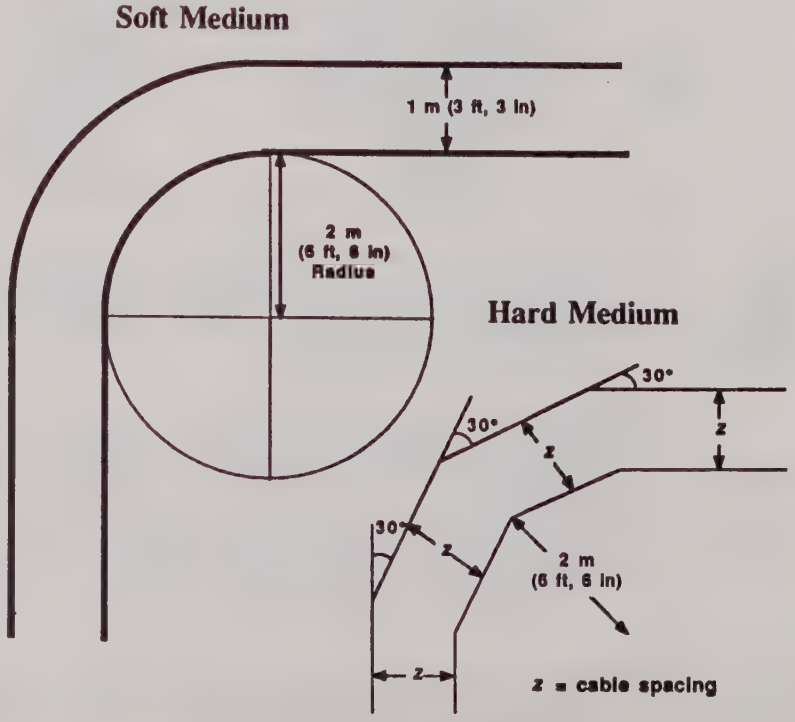
5. Make Gradual Turns

The sensor cables can follow almost any path, but must not be turned too sharply. Normally, the detection field follows the cable path. But at a sharp turn the detection field can "swing wide" the same way a car will skid outwards on a sharp curve.

To minimize this effect:

- follow a smooth curve with a minimum inside radius of 2 m (6 ft, 6 in), when turning in a soft medium such as soil or gravel
- make 90° turns using three successive 30° turns, when turning in a hard medium such as concrete or asphalt

The detection field can be distorted by steep slopes the same way it can be distorted by sharp turns. Limit the change in grade of the cables to 30° or less.



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6. Avoid Obstacles

Keep both sensor cables at least 2 m (6 ft, 6 in) away from obstacles such as:

- buildings
- metal fences or other metal objects
- standing water (ponds, ditches, or poorly drained areas)
- large, non-metallic drainage pipes

If the cables are routed near a building, ensure they are not directly under the drip line of the roof.

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Checking the Site Plan

Check the Design

When you see the site plan for the first time, check the design of the system against the guidelines given in the Six Steps to Success. If you see parts of the design that can be improved, mark the changes on the site plan for future reference. Sometimes, the guidelines have to be broken because of the nature of the site. However, you must follow the guidelines wherever possible.

Up-to-Date Design

It's quite possible that the Panther system originally designed for the site you are installing can now be installed at a lower cost by using newer components or techniques. Make sure you're using the most up-to-date components and techniques.

Use Your Experience

Although you might have the best sales and design force in the industry, they're not "down in the trenches" installing the equipment. You may be able to make design changes that improve system performance or reduce installation costs. Let your designers know when you've changed their design so they can adjust their practices.

Look for Errors

People make mistakes. If you can spot design or specification errors before you get to the customer's site, you can save your company money and embarassment.

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Parts You Will Need

Single Zone System

- ☐ one Panther detection unit — Order #: OI-200051-00
- ☐ one load set — Order #: OI-200066-00
- ☐ one terminator set — Order #: OI-200065-00

one of the following:

- ☐ set of sensor cables, 100 m (328 ft) — Order #: OI-200052-01
- ☐ set of sensor cables, 150 m (492 ft) — Order #: OI-200052-02

Two-Zone System

- ☐ one Panther detection unit — Order #: OI-200051-00
- ☐ for zone A:
  - ☐ one terminator set — Order #: OI-200065-00

  one of the following:
  - ☐ set of sensor cables, 100 m (328 ft) — Order #: OI-200052-01
  - ☐ set of sensor cables, 150 m (492 ft) — Order #: OI-200052-02
- ☐ for zone B:
  - ☐ one terminator set — Order #: OI-200065-00

  one of the following:
  - ☐ set of sensor cables, 100 m (328 ft) — Order #: OI-200052-01
  - ☐ set of sensor cables, 150 m (492 ft) — Order #: OI-200052-02

Two-Zone Decoupled System

- ☐ one Panther detection unit — Order #: OI-200051-00
- ☐ one decoupler set — Order #: OI-200064-00
- ☐ for zone A, one of the following:
  - ☐ set of sensor cables, 100 m (328 ft) — Order #: OI-200052-01
  - ☐ set of sensor cables, 150 m (492 ft) — Order #: OI-200052-02
- ☐ for zone B, one of the following:
  - ☐ set of sensor cables, 100 m (328 ft) — Order #: OI-200052-01
  - ☐ set of sensor cables, 150 m (492 ft) — Order #: OI-200052-02

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Spare Parts Accessories

☐ single sensor cables, 100 m (328 ft)	Order #: SP-100044-00
☐ single sensor cables, 150 m (492 ft)	Order #: SP-100045-00
☐ single non-detecting cables, 50 m (164 ft)	Order #: SP-100022-00
☐ splice kit	Order #: OI-200068-00
☐ ferrite bead kit (package of 10)	Order #: OI-200069-00
☐ load	Order #: EM-200526-00
☐ male connector	Order #: TO381
☐ female connector	Order #: TO380
☐ female to female adapter	Order #: TO395
☐ shrink tubing kit	Order #: OI-200070-00
☐ cable identification label	Order #: SP-100051-00
☐ decoupler	Order #: EM-200524-00
☐ terminator	Order #: EM-200525-00
☐ Panther cable stripping tool	Order #: T0394
☐ Panther crimping tool	Order #: T0378
☐ TNC/Banana plug adapter cable	Order #: CD-200940-00

Tools and Materials You Will Need

Standard Tools

- ☐ Panther cable stripping tool
- ☐ Panther crimping tool
- ☐ electronic toolkit (side cutters, needle-nose pliers, screwdriver, etc.)
- ☐ ohmmeter
- ☐ chart recorder
- ☐ electric drill (cordless, if necessary)
- ☐ extension cord
- ☐ Panther Installer's Checklist (you will find one at the back of this book)
- ☐ this book
- ☐ female to female adapter
- ☐ TNC/Banana plug adapter cable

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Cable Burial Tools

Note that some items (*) are needed only for pavement burial.

- ☐ cable burial marker stakes
- ☐ flourescent marker paint
- ☐ chalk line
- ☐ shovel
- ☐ rake
- ☐ trenching machine
- ☐ sod slitter or remover
- ☐ concrete saw*
- ☐ sand
- ☐ pavement sealant (Dow Corning 888, 3M Traffic Loop Sealant)*

If cable burial is being performed by an outside contractor, you may wish to check the specifications for burial. Schedule your work in a way that allows you to perform a quick test of the system BEFORE the cables are permanently buried.

Damp Weather Tools

WARNING! - all sensor cable connections must be absolutely dry. Trapped moisture leads to corrosion and system failure. Avoid damp weather installations. If you must install the sensor cables in damp conditions you will need:

- ☐ heat gun/radiant heater
- ☐ extension cord
- ☐ propane heater/dryer (if no power is available)

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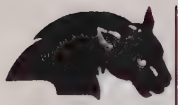
Making Connections and Splices

Installing Connectors

Installing Terminators and Decouplers

Splices and Cable Repairs



Installing Connectors

System reliability depends directly on proper connections. Most problems can be traced to poorly installed connectors. Avoid call-backs! Follow the recommended procedures.

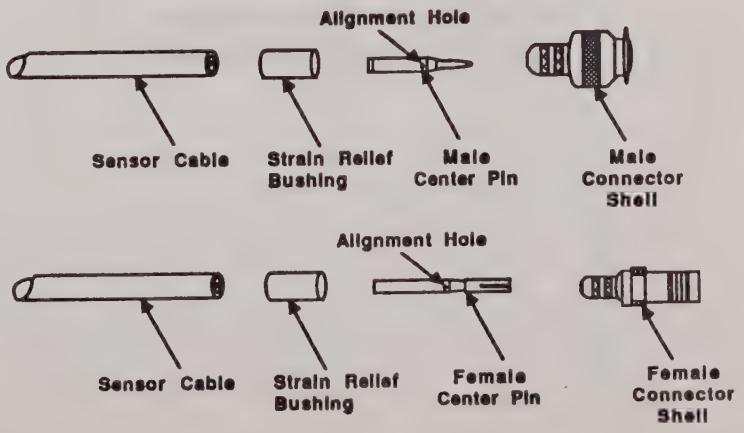
Connectors are used to:

- join the sensor cables to the detection unit
- attach terminators to sensor cables
- attach decouplers to sensor cables
- make splices

The TNC connectors supplied with Panther have been specially designed to work with the sensor cable. Do not substitute any other connectors. If you do, system performance will be seriously affected.

The installation procedure is the same for both male and female connectors even though the head shells and center pins are different.

Connector Parts



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Key Points

Note the following:

- **All connections must be dry.** Trapped moisture can cause corrosion, reduced performance, and system failure. Use a heat gun to remove any moisture.
- Do not drop or place the connectors, cable ends, terminators, or decouplers on the ground or allow them to get wet or dirty.
- Do not put connectors on the cables until just before you connect them to the detection unit, decoupler, or terminator.
- Use the Panther cable stripping tool to ensure proper strip length and to avoid damaging the cable.
- Use the Panther crimp tool to ensure proper crimping of connectors to the sensor cable.
- Do not use the Panther crimp tool on other connectors; you may damage the tool.

If the connectors are used for cable splicing or repair, they must be made completely waterproof. See the Cable Splicing and Repair section for details.

Tools and Materials

- Panther TNC connector
- one nylon "zip-tie"
- Panther crimp tool
- Panther coaxial cable stripping tool
- side cutters
- heat gun with extension cord (in damp locations)
- ohmmeter
- TNC female to female adapter
- TNC/Banana plug adapter cable

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Procedure

1. Examine the connector package and make sure it contains:

   - connector body or "headshell" (male or female)
   - connector center pin (male or female)
   - strain relief bushing

2. The end of the cable may be roughly trimmed. Cleanly cut off the end of the cable with side cutters.

3. Fasten the nylon tie about 0.5 m (1 ft, 8 in) along the cable. It will keep the strain relief bushing from sliding down the cable into the dirt.

4. Slide the strain relief bushing onto the cable.

5. Set the stripping tool so that the number 5 is showing in the window.

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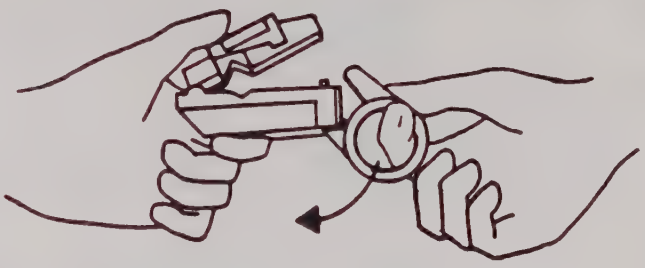
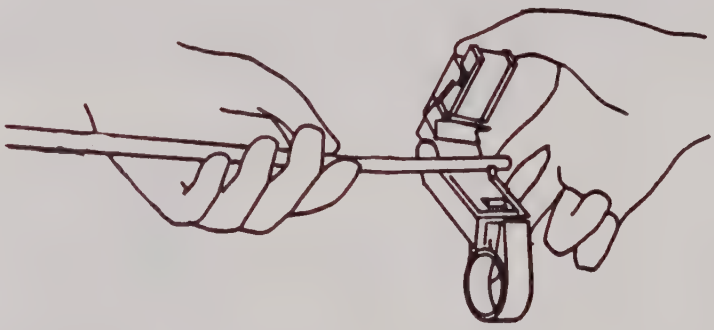
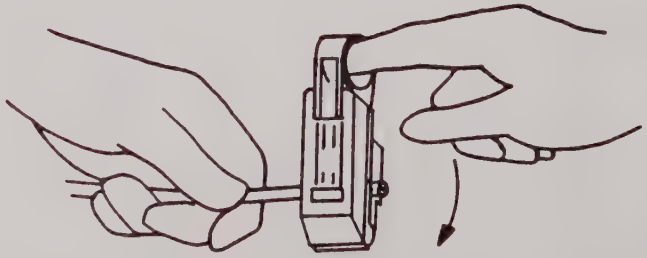
6. Open the stripping tool by pulling down the ring at the end of the tool as shown below.



7. Hold the cable in your left hand and clamp the cable stripping tool onto the cable about 12 mm (1/2 in) from the end of the cable as shown below.



8. Rotate the tool several times so the knives can make their cuts.



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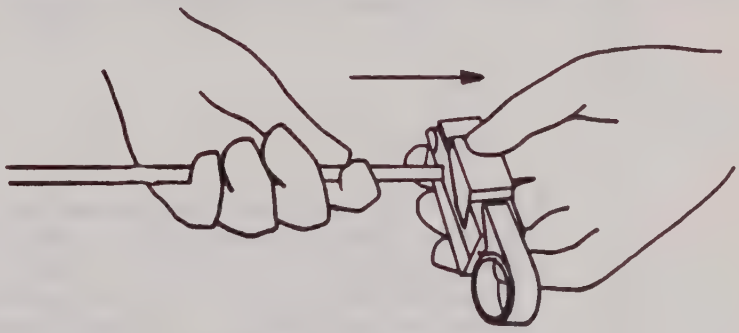
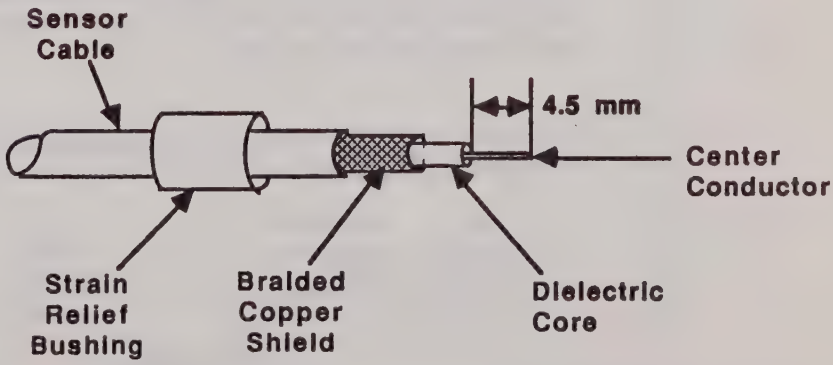
9. Reset the stripping tool so that the number 4 is showing in the window.

10. Rotate the tool several times again.

11. Reset the stripping tool so that the number 5 is showing in the window. Leave the tool closed and pull it off the end of the cable.



12. Trim the center conductor so that 4.5 mm (0.177 in) of the center conductor is exposed.



13. If foil covers the dielectric core, ensure that the foil does not short to the center conductor. You may remove all of the exposed foil covering if you wish.

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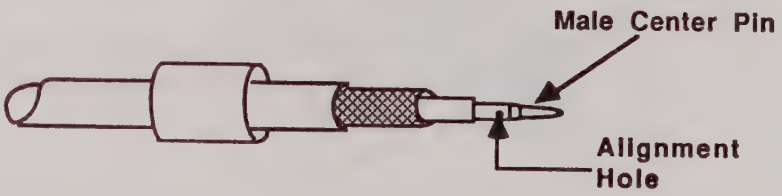
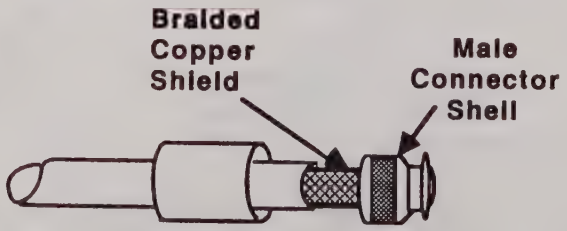
14. Slide the center pin onto the center conductor until it butts against the dielectric core. Look through the small hole in the side of the pin. The center conductor should be visible in the alignment hole.



15. If the end of the cable is straight and the pin is in the right position, crimp it in place with the crimp tool. Use the small square hole of the crimp tool and crimp as close as possible to the dielectric core. WARNING: the crimp tool is rachet driven and must travel a full stroke before it will release -- careless operation can result in personal injury!

16. Check the center pin. It must be solidly attached. If it wiggles, remove it and try again with a new center pin. DO NOT solder the pin! If you solder, the dielectric will expand and prevent proper assembly.

17. Slide the connector headshell onto the end of the cable over the dielectric core and beneath the copper braid.



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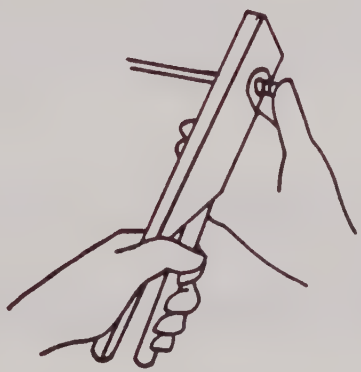
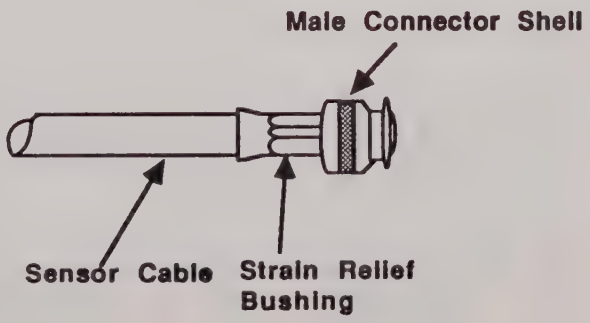
18. Smooth the copper braid towards the headshell.

19. Slide the strain relief bushing up the cable until it rests against the back surface of the headshell.

20. Place the crimp tool against the back of the headshell and crimp the strain relief bushing to the cable using the large hexagonal hole of the crimp tool. Hold your thumb against the headshell to ensure that the headshell doesn't slide away from the bushing during crimping.





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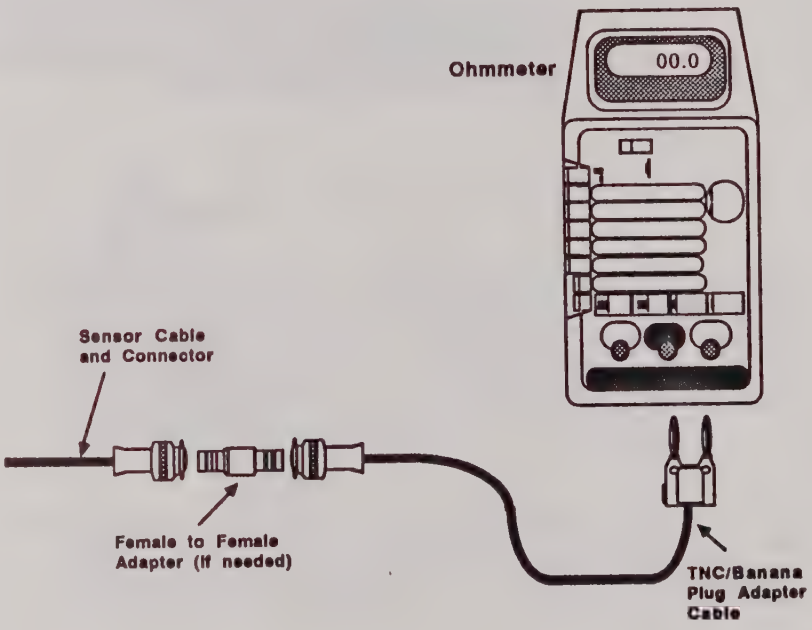
21. Make sure the center pin is not shorted against the headshell on the connector. Attach the TNC/Banana plug adapter to the connector (use the TNC female to female adapter if necessary). Attach an ohmmeter to the banana plugs and check for intermittent shorts by wiggling the connector.



22. Place the appropriate label onto the cable near the connector. Apply the printed portion of the label first so that the clear portion ends up covering it.

23. If this is an underground connection, see the Cable Splicing and Repair section for instructions on waterproofing connectors.

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Installing Terminators and Decouplers

Installing terminators and decouplers is fast and very easy. Terminators and decouplers are simply attached to male connectors fastened to the sensor cables. The terminators and decouplers are then covered with Panther shrink tubing to waterproof the connnections.

Panther terminators and decouplers have 130 kΩ supervision resistors built into them. Panther's detection electronics look for this resistance in order to monitor the sensor cables for failure or sabotage. You don't have to supply any extra components for this built-in feature.

Terminators, decouplers, and the detection unit sensor cable inputs all contain components that can be damaged by voltages above 600 Vdc. DO NOT use any high-voltage cable-leakage testers (or "Meggers") on the sensor cables unless the terminators, decouplers, and detection unit have been disconnected.

System reliability depends directly on proper connections. Most problems can be traced to poorly installed connectors. Avoid call-backs! Follow the recommended procedures.

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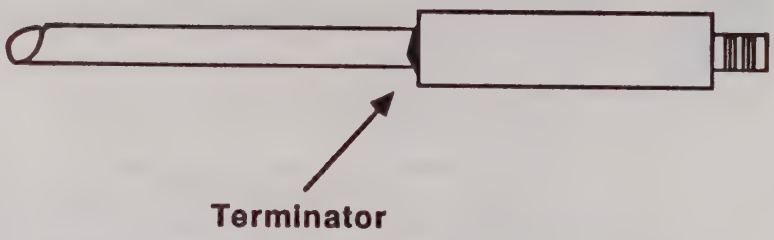
Terminator



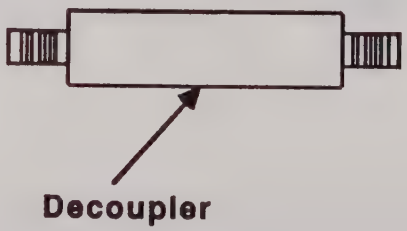
A terminator consists of:

- a cylindrical tube 7 cm (3 in) long and 1.5 cm (0.6 in) in diameter enclosing an electronic circuit
- an integral female Panther TNC connector on one end
- an integral 4 m (13 ft) stub of cable on the other end

Terminators are attached to the ends of sensor cables to:

- provide a supervision resistor for the sensor cables
- provide rf termination for the sensor cables
- allow the detection field to dissipate in a controlled manner (the field follows the path of the cable stub)

Decoupler



A decoupler consists of:

- a cylindrical tube 7 cm (3 in) long and 1.5 cm (0.6 in) in diameter enclosing an electronic circuit
- an integral female Panther TNC connector on each end

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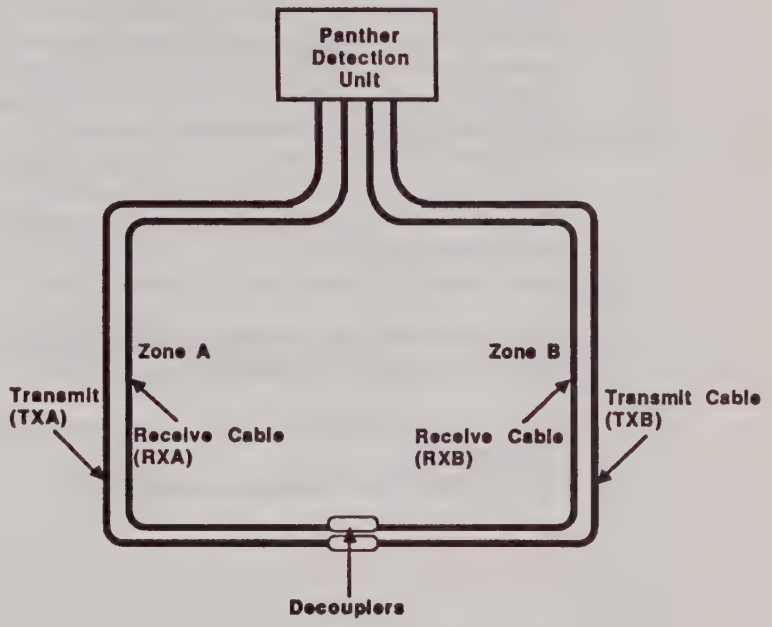
If you're using two zones to completely surround one area, you can use two decouplers to join the ends of the sensor cables in one zone to the ends of the sensor cables in the other zone. The transmit cables of each zone and the receive cables of each zone are connected together using decouplers.



The decouplers:

- prevent the two zones from interfering with each other
- provide supervision resistors for the sensor cables
- provide rf termination for the sensor cables
- allow the detection fields for each zone to dissipate while providing full coverage at the zone boundary

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Note the following:

- **All connections must be dry.** Trapped moisture can cause corrosion, reduced performance, and system failure. Use a heat gun to remove any moisture.
- Do not drop or place the connectors, cable ends, terminators, or decouplers on the ground or allow them to get wet or dirty.
- Do not put connectors on the cables until just before you connect them to the detection unit, decoupler, or terminator.
- Use the Panther cable stripping tool to ensure proper strip length and to avoid damaging the cable.
- Use the Panther crimp tool to ensure proper crimping of connectors to the sensor cable.
- Do not use the Panther crimp tool on other connectors; you may damage the tool.

Since decouplers and terminators are always buried, they must be made completely waterproof.

- Use an ohmmeter to do a continuity check prior to waterproofing.
- Use the approved Panther shrink tubing.

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Tools and Materials

Whenever you install terminators or decouplers, you will need the following:

- Panther terminator or decoupler kit which includes:
  - 2 terminators or decouplers
  - 2 pieces of Panther shrink tubing
  - 1 roll of putty tape
  - 1 cable preparation kit

- male Panther TNC connectors (1 for terminators, 2 for decouplers)
- Panther crimp tool
- Panther cable stripping tool
- side cutters
- heat gun with extension cord (in damp locations).
- ohmmeter
- TNC female to female adapter
- TNC/Banana plug adapter cable

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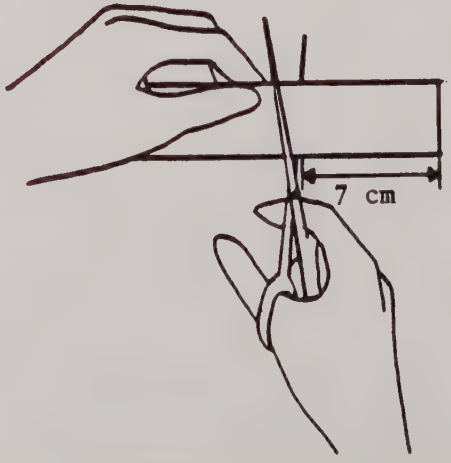
Terminator Installation Procedure

1. Install a male Panther TNC connector on one sensor cable. Use the procedure given in the Installing Connectors section.

2. Rub 8 cm (3 in) of the cable with the sandpaper from the cable preparation kit and wipe the cable with the supplied cleaning cloth. This roughens and cleans the cable surface for a good bond to the putty tape. Also prepare the cable stub that comes out of the terminator body.

3. Cut two 7 cm (2 3/4 in) strips of putty tape.



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4. Place one piece of putty tape lengthwise along the cable flush against the connector headshell. The distance from the back of the headshell to the end of the tape should be 7 cm (2 3/4 in).

5. Mold the tape around the cable.

6. Place the other piece of putty tape lengthwise along the cable stub and flush against the back of the terminator body.

7. Mold the tape around the cable.

8. Slide the shrink tubing onto the cable so that the long plastic strip inside the tubing trails out toward the connector.

9. Connect the terminator to the male connector.

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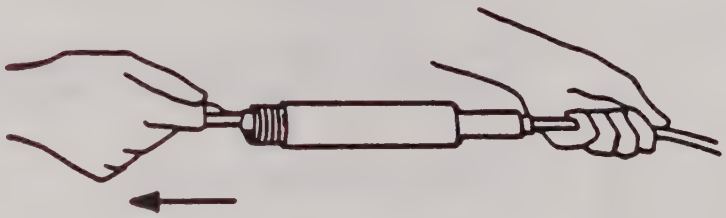
10. Use an ohmmeter to test the sensor cable connection. You should detect the 130 KΩ supervision resistor in the terminator.

11. Hold the shrink tubing over the terminator so that 0.5 - 1 cm (1/4 - 1/2 in) of the putty tape on the connector cable is exposed.

12. Collapse the shrink tubing around the terminator by pulling and unwinding the plastic tape wound inside the tubing. Make sure you collapse the tubing so that 0.5 - 1 cm (1/4 - 1/2 in) of the end of the putty tape on the connector cable is exposed. The shrink tubing lengthens as it collapses and should center over the terminator.



13. Repeat the procedure for the other cable.

Decoupler Installation Procedure

1. Install a male Panther TNC connector on one sensor cable. Use the procedure given in the Installing Connectors section.

2. Install a male Panther TNC connector on the corresponding cable (transmit or receive cable) for the other zone.

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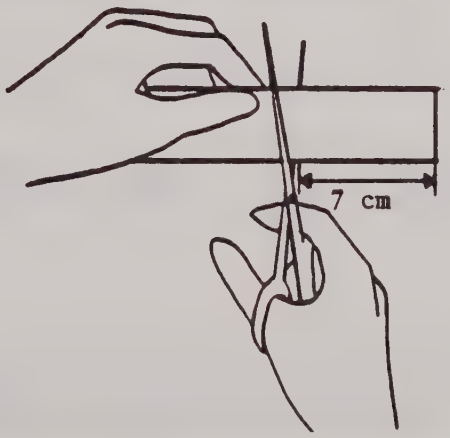
3. Rub 8 cm (3 in) of each cable with the sandpaper from the cable preparation kit and wipe the cables with the supplied cleaning cloth. This roughens and cleans the cable surface for a good bond to the putty tape.

4. Cut two 7 cm (2 3/4 in) strips of putty tape.



5. Place one piece of the putty tape lengthwise along each cable flush against the connector headshells. The distance from the back of each headshell to the ends of each tape should be 7 cm (2 3/4 in).

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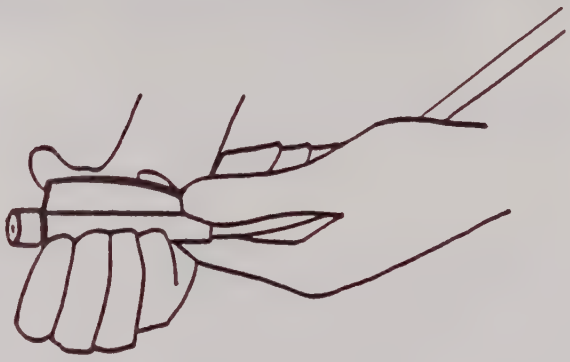
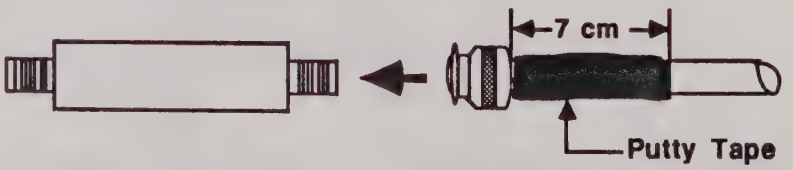
6. Mold the tape around each cable.



7. Slide the shrink tubing onto one cable so that the long plastic strip inside the tubing trails out toward the connector.

8. Connect the decoupler to the male connectors.



9. Use an ohmmeter to test the sensor cable connections for both zone A and B. You should detect the 130 KΩ supervision resistor in the decoupler.

10. Hold the shrink tubing over the decoupler so that 0.5 - 1 cm (1/4 - 1/2 in) of putty tape is exposed on one cable.

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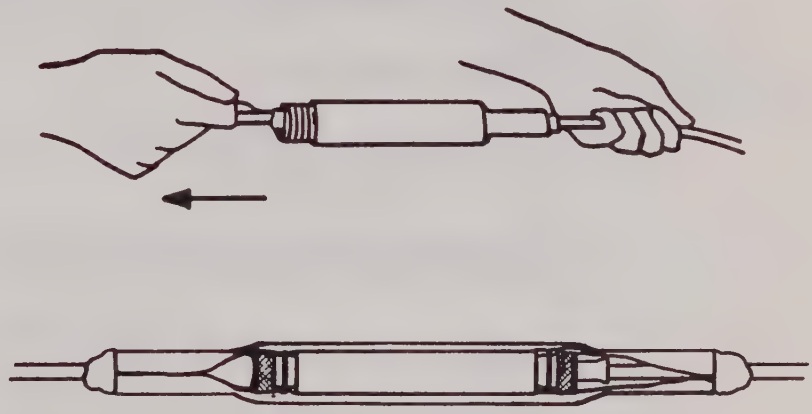
11. Collapse the shrink tubing around the decoupler by pulling and unwinding the plastic tape wound inside the tubing. Make sure you begin collapsing the tubing so that 0.5 - 1 cm (1/4 - 1/2 in) of the end of putty tape remains exposed. The shrink tubing will stretch as it collapses and should center over the decoupler.



12. Repeat the procedure for the other two cables.

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Splices and Cable Repairs

Using Splices

Splices are used:

- to provide non-detecting sections in the middle of a detecting zone
- to repair a damaged cable

DO NOT use splices to lengthen a cable! Cable length must fall within the following limits:

- The detecting section: 10 to 150 m (33 to 492 ft).
- The lead-in section: 10 to 50 m (33 to 164 ft).

Never splice a piece of detecting cable into non-detecting cable.

Non-detecting cable must not be spliced into detecting cable except to provide a non-detecting section (called a bypass) within a detecting area. See the Installing the Cables section for more information about installing bypass areas.

Determining Cable Type

Before you make repairs or splices, determine the type of cable you're working on.

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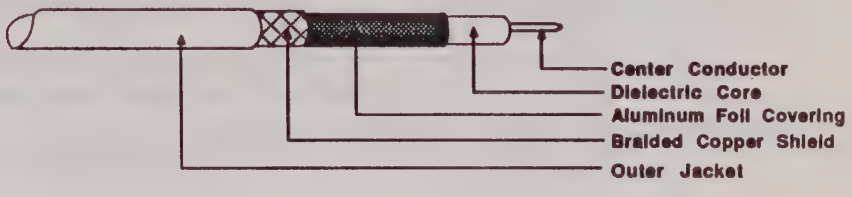
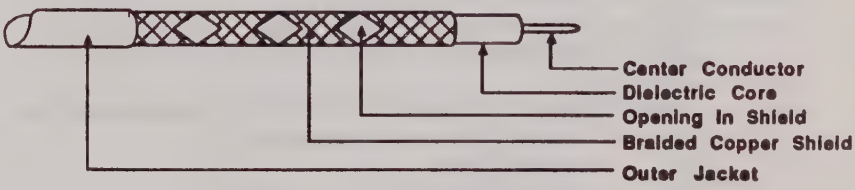
Non-detecting cable has:

- a foil layer
- a solid layer of copper braid



Detecting cable has:

- no foil layer
- diamond-shaped holes in the copper braid



Assessing Cable Damage

Cable damage is catagorized as:

- Superficial - a very small cut or scrape on the outer jacket
- Minor - a cut less than 1 cm (3/8 in) in length
- Moderate - a damaged section less than 2.5 cm (1 in) in length
- Severe - a damaged section more than 2.5 cm (1 in) but less than 3 m (9 ft, 9 in) in length
- Irreparable - a damaged section more than 3 m (9 ft, 9 in) in length

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What appears to be only superficial damage may be quite extensive. If the cut or abrasion has gone through the outer jacket, carefully examine the cut.

- If corrosion is visible, cut back the jacket until you reach an uncorroded section. Classify the damage based on the length of jacket you have stripped.
- If the dielectric is damaged, the damage is moderate.
- If four or more strands of the copper braid are broken, the damage is minor.
- If three strands or less of the braid are broken, the damage is superficial.

Tools and Materials

You should have the following tools and materials available whenever you repair cables:

- Panther cable splice kit which includes:
  - two male TNC connectors
  - two female TNC connectors
  - one cable preparation kit
  - one roll of putty tape
  - two pieces of shrink tubing
  - three meters of detecting cable
- standard tools for installing connectors (see the Making Connections and Splices section)
- electrical tape
- female to female TNC adapter
- TNC/Banana plug adapter cable
- ohmmeter

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Repairing Superficial Damage

1. Rub the cable jacket with sandpaper from the cable preparation kit and wipe the cable with the supplied cleaning cloth. This roughens and cleans the cable surface for a good bond to the putty tape.

2. Wrap overlapping layers of putty tape around the damaged section.

3. Wrap electrical tape over the putty tape for extra mechanical protection.

Repairing Minor Damage [Less Than 1 cm (3/8 in)]

1. Cut the cable at a point near the center of the damaged area. Strip each end with the Panther stripping tool.

2. If corrosion is present, assess the damage (it may be Moderate or Severe). If corrosion is not present, proceed with the next step.

3. Install a male connector on one cut cable end and install a female connector on the other cable end. Use the procedures given in the Making Connections and Splices section.

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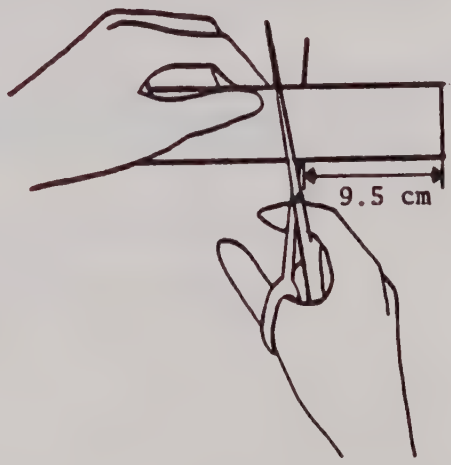
4. Rub 10 cm (4 in) of each cable with the sandpaper from the cable preparation kit and wipe the cables with the supplied cleaning cloth. This roughens and cleans the cable surface for a good bond to the putty tape.

5. Cut two 9.5 cm (3 3/4 in) strips of putty tape.



6. Place the putty tape lengthwise along each cable flush against the connector headshells. The distance from the back of each headshell to the ends of each tape should be 9.5 cm (3 3/4 in).

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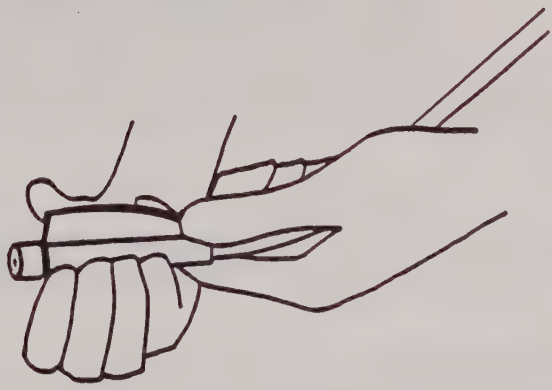
7. Mold the tape around each cable.



8. Slide the shrink tubing onto one cable so that the long plastic strip inside the tubing trails out toward the connector.

9. Connect the female connector to the male connector.

10. Hold the shrink tubing over the connectors so that 0.5 -1 cm (1/4 - 1/2 in) of putty tape is exposed on one cable.

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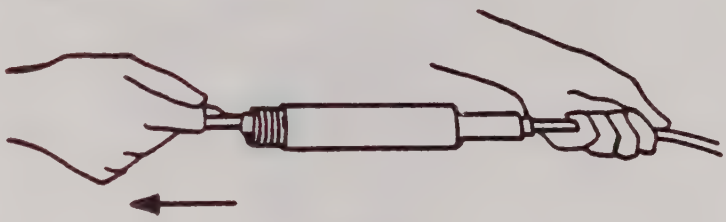
11. Collapse the shrink tubing around the connectors by pulling and unwinding the plastic tape wound inside the tubing. Make sure you begin collapsing the tubing 0.5 -1 cm (1/4 - 1/2 in) from the end of one of the pieces of tape. The shrink tubing will stretch as it collapses and should center over the connectors and tape.



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Repairing Moderate Damage [Less Than 1.5 cm (1 in)]

1. Cut out the damaged section of the cable (cut out a piece the same length as the female to female adapter). Strip each end using the Panther stripping tool.

2. If corrosion is present, assess the damage (it may be Severe). If corrosion is not present, proceed with the next step.

3. Install male connectors on both cables. Use the procedures given in the Making Connections and Splices section.

4. Rub 10 cm (4 in) of each cable with the sandpaper from the cable preparation kit and wipe the cables with the supplied cleaning cloth. This roughens and cleans the cable surface for a good bond to the putty tape.

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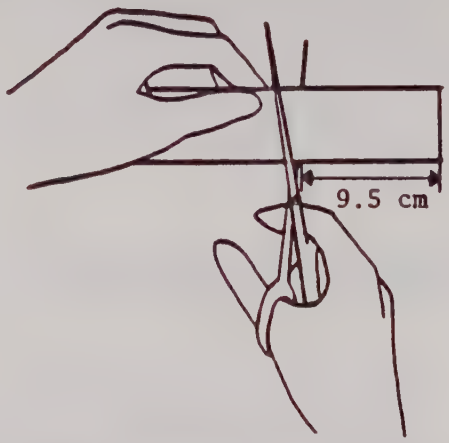
5. Cut two 9.5 cm (3 3/4 in) strips of putty tape.



6. Place the putty tape lengthwise along each cable flush against the connector headshells. The distance from the back of each headshell to the ends of each putty tape should be 9.5 cm (3 3/4 in).

7. Mold the tape around each cable.

8. Slide the shrink tubing onto one cable so that the long plastic strip inside the tubing trails out toward the connector.

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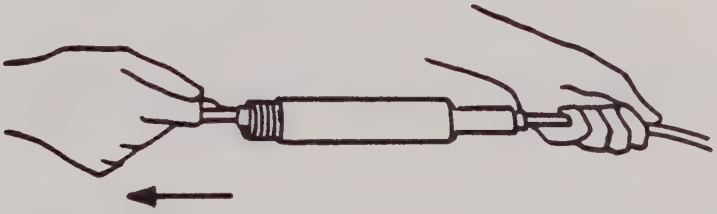
9. Connect the two male connectors together with the female to female adapter.

10. Hold the shrink tubing over the connectors so that 0.5 - 1 cm (1/4 - 1/2 in) of tape is exposed on one cable.

11. Collapse the shrink tubing around the connectors by pulling and unwinding the plastic tape wound inside the tubing. Make sure you begin collapsing the tubing 0.5 - 1 cm (1/4 - 1/2 in) from the end of one of the pieces of tape. The shrink tubing will stretch as it collapses and should center over the connectors and tape.



Repairing Severe Damage [Less Than 3 m (9 ft, 9 in)]

1. Cut out the damaged section of the cable (cut out a piece shorter than 3 m). Strip the ends with the Panther stripping tool.

2. If corrosion is present, assess the damage (it may be irreparable). If corrosion is not present, proceed with the next step.

3. Install a male connector on one cut cable end and another male connector on the other cable end. Use the procedures given in the Making Connections and Splices section.

4. Cut the spare cable to length.

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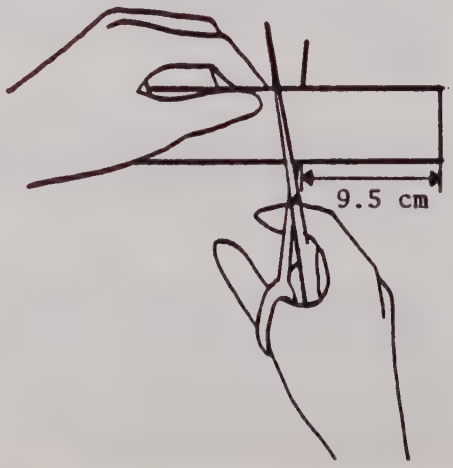
5. Install female connectors on both ends of the spare cable.

6. Rub 10 cm (4 in) of each cable with the sandpaper from the cable preparation kit and wipe the cables with the supplied cleaning cloth. This roughens and cleans the cable surface for a good bond to the putty tape.

7. Cut four 9.5 cm (3 3/4 in) strips of putty tape.



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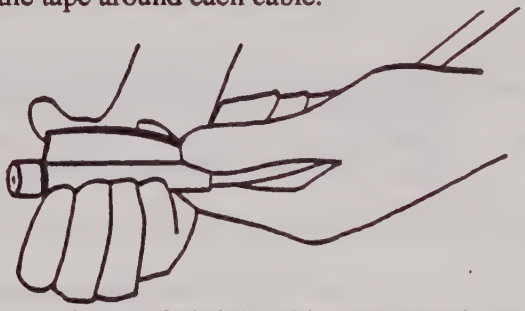
8. Place the putty tape lengthwise along each cable flush against the connector headshells. The distance from the back of **each** headshell to the ends of each putty tape should be 9.5 cm (3 3/4 in).

8. Mold the tape around each cable.

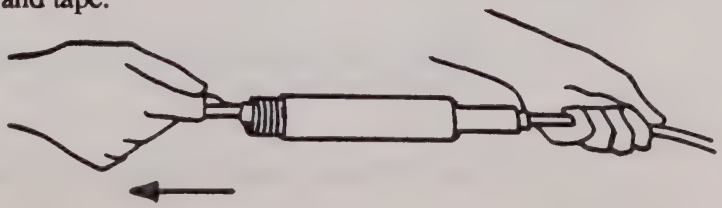


10. Slide two pieces of shrink tubing onto each end of the cut cable so that the long plastic strip inside the tubing trails out toward the connector.

11. Splice the spare cable into the cut cable by connecting the two male connectors to the female connectors on the spare cable.

12. Hold the shrink tubing over the connectors so that 0.5 - 1 cm (1/4 - 1/2 in) of putty tape is exposed on one cable.

13. Collapse the shrink tubing around the connectors by pulling on the plastic tape wound inside the tubing. Make sure you begin collapsing the tubing 0.5 - 1 cm (1/4 - 1/2 in) from the end of one of the pieces of tape. The shrink tubing will stretch as it collapses and should center over the connectors and tape.



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Irreparable Damage [More Than 3 m (9 ft, 9 in)]

DO NOT attempt to splice in new cable where more than 3 m (9 ft, 9 in) of the detecting section has been damaged. Replace the entire cable or use the procedure given below.

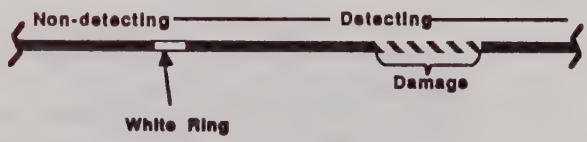
Alternative to Cable Replacement

If the cable has been buried in concrete, for example, it may be impractical to replace the entire cable. In this case it's permissible to splice in a new section of cable to replace the damaged section, provided that the procedures described below are used.

Be very careful when replacing a damaged section that includes detecting cable. The interior "ports" or holes inside the detecting cable get bigger along its length. You must make sure that the new section of cable has holes in the braid that are the same size as the holes in the damaged section.

You can replace a long section of damaged cable by doing the following:

1. Measure (or estimate) the length from the "white ring" to the end of the damaged section.



2. Obtain a new sensor cable that is as long or longer than the measured or estimated length.

3. Unroll the new cable along the path of the damaged cable.

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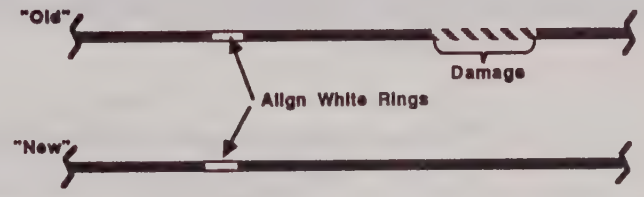
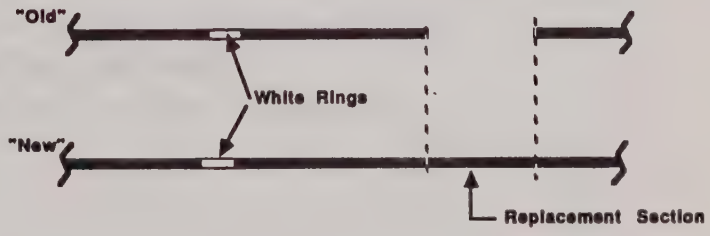
4. Make sure both cables have the non-detecting section at the same end.

5. Align the "white marks" on the old and new cables.



6. Cut out and discard all of the damaged cable section.

7. Cut a section out of the new cable which is at the same location as the section removed from the damaged cable.



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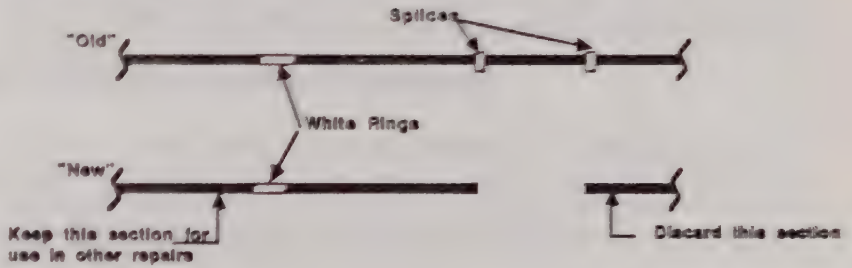
8. Splice the new cable section into the damaged cable.

9. Keep the end of the new cable that includes the non-detecting section of the new cable. It can be used in future repairs or in locations where you need a short cable.

10. Discard the unused detecting portion of the new cable. DO NOT use it for future repairs. The holes in the braid will be the wrong size.



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Installing the Cables

Preparing the Site
Routing the Sensor Cables
Obstacles
Bypass Areas
Preparing the Cables
Cutting Cable Channels - An Overview
Installing in Soil
Installing in Gravel
Surface Slots in Concrete/Asphalt
Burial Beneath Concrete/Asphalt
Installing an Overlap
Running Lead-in Cable Indoors

Preparing the Site

Doing a Site Survey

The site may have changed since the original survey. Perform the following check of the cable route.

1. Walk along the proposed sensor cable route.
2. Note any obstacles along the sensor cable route.
3. Measure areas where the cables turn or approach obstacles.
4. Check for buried metallic objects with a metal detector.
5. Determine how the cables can enter the building where the detection unit is to be mounted.

The detection electronics must be mounted indoors, inside the customer's building. Make sure that:

- the temperature stays within the range 0°-50°C (32°-122°F)
- 12 Vdc ±15% @ 750 ma power is available
- wall space is available for the detection unit (34.2 cm high x 26.2 cm wide x 8.9 cm deep) (13.5 in x 10.3 in x 3.5 in)
- the area surrounding the proposed mounting location is clear

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Routing the Sensor Cables

Cable Patterns

The sensor cables can be routed in one of two basic patterns:

- closed loop
- open loop

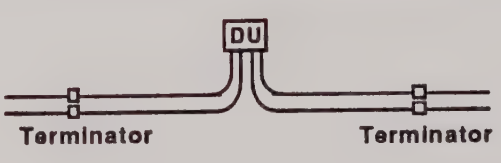
A closed loop completely surrounds the area to be protected.

An open loop does not surround an area.

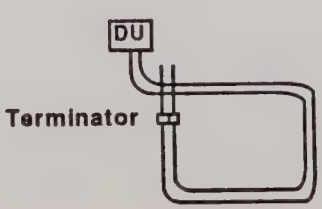
Since Panther can monitor two different zones, there are many routing combinations possible.

Single Zone, Open Loop

Two Zones, Open Loops



Single Zone, Closed Loop



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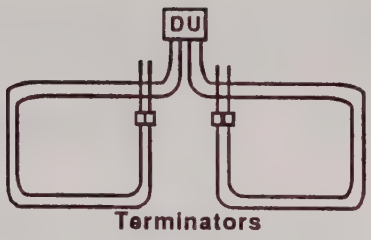
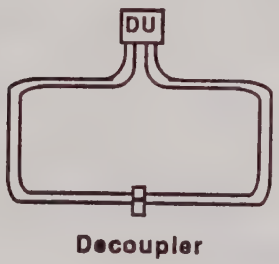
Two Zones, Closed Loops



Two Zones, Decoupled Loops



Closed Loops

In single- and two-zone closed loop configurations, the cable route crosses over itself at the end of each zone. The cable crossing must be designed to:

- avoid interference
- provide full-strength coverage

These goals can be achieved by:

- crossing the cables at 90°
- making sure the end of the cable route crosses itself at a point where the detection field is at full strength

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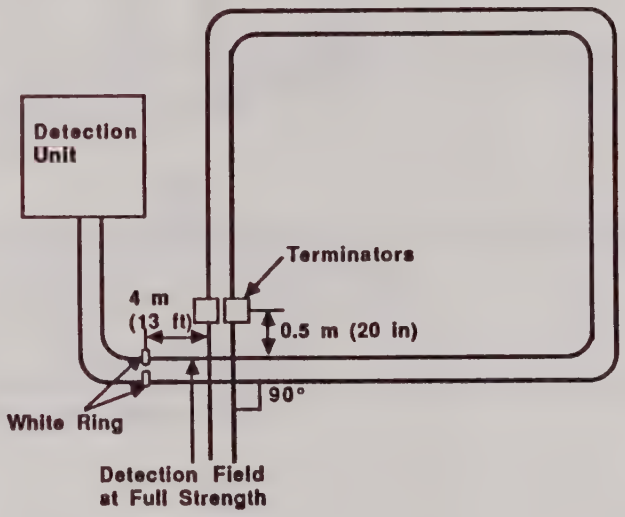
A terminator is used at the end of each zone. The 4 m (13 ft) cable stub on the end of the terminator is what actually crosses the full-strength section of the zone.



Decoupled Loops

A special type of closed loop is formed by a two-zone decoupled system. The sensor cables from each of the two zones are joined together using decouplers. The decouplers stop the detection field at the end of each zone and help provide full-strength coverage.

For two-zone, decoupled configurations, the sensor cables usually overlap near the cable entrance area to completely enclose the perimeter. This overlap area is:

- 8 m (26 ft) long
- 1.5 m (5 ft) wide

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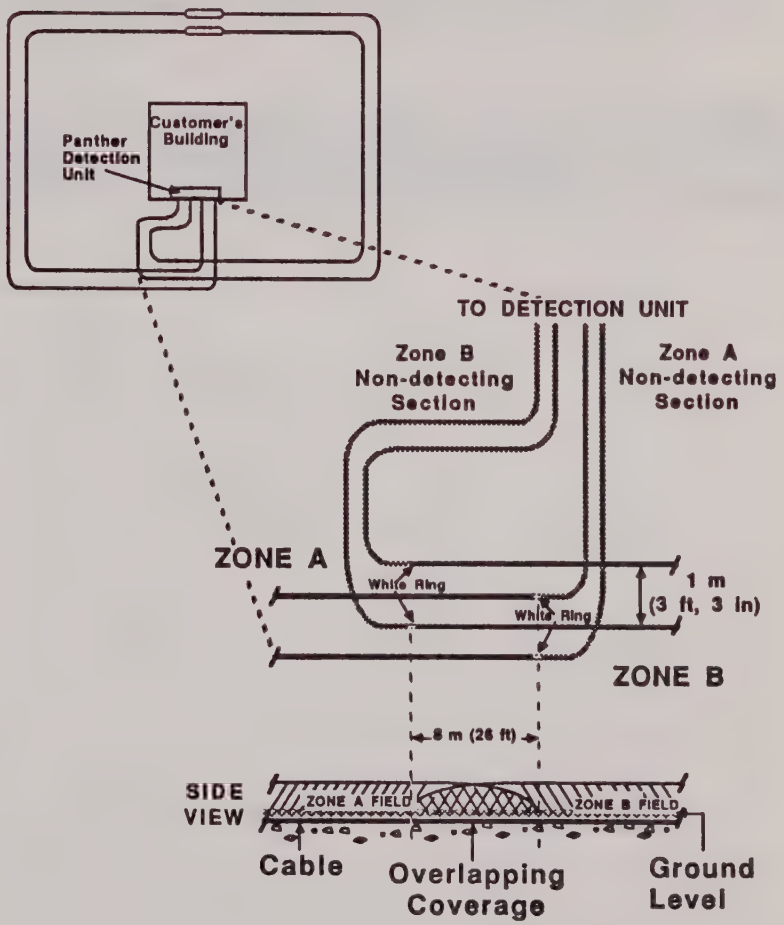
Make sure there is enough room for the overlap to be installed.



The cables cross over each other at the overlap. When crossing over cables:

- cross the cables at 90°
- ensure a vertical separation of at least 15 cm (6 in) where the cables cross over each other

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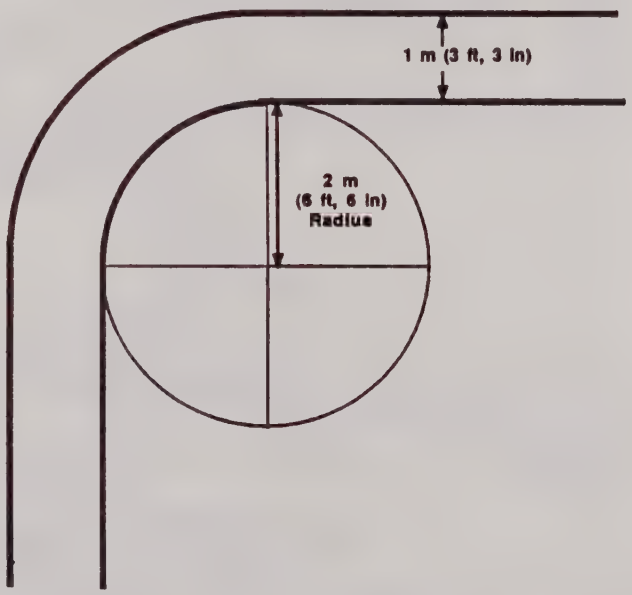
Cable Spacing

The distance between the parallel sensor cables must be constant within each zone. The standard spacing is 1 m (3 ft, 3 in). For vehicle protection applications, the optional spacings of 2 m (6 ft, 6 in) or 3 m (9 ft, 9 in) can be used.

Turning Corners - Soft Medium

Where the cables must turn corners, use a smooth curve with a minimum inside corner radius of 2 m (6 ft, 6 in). This will minimize the "overshoot" of the detection field and keep the field centered between the cables.



The radius for the outside cable will be:

- 3 m (9 ft, 9 in) for a cable spacing of 1 m (3 ft, 3 in),
- 4 m (13 ft) for a cable spacing of 2 m (6 ft, 6 in), or
- 5 m (16 ft, 3 in) for a cable spacing of 3 m (9 ft, 9 in).

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Turning Corners - Hard Medium

Where the cables must turn corners in pavement, it's impractical (if not impossible) to cut smooth curves. Instead, cut a series of straight segments with each segment changing direction by a maximum of 30°. A 90° corner requires three 30° turns in succession.

Procedures are given which show you how to lay out three 30° turns when using 1 m or 3 m spacings. A procedure is also given for laying out turns when you're using spacings other than 1 m or 3 m.

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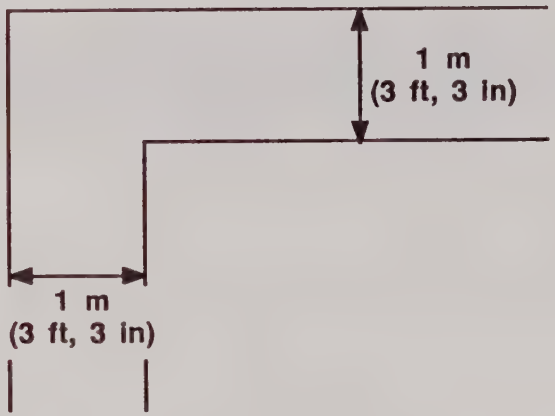
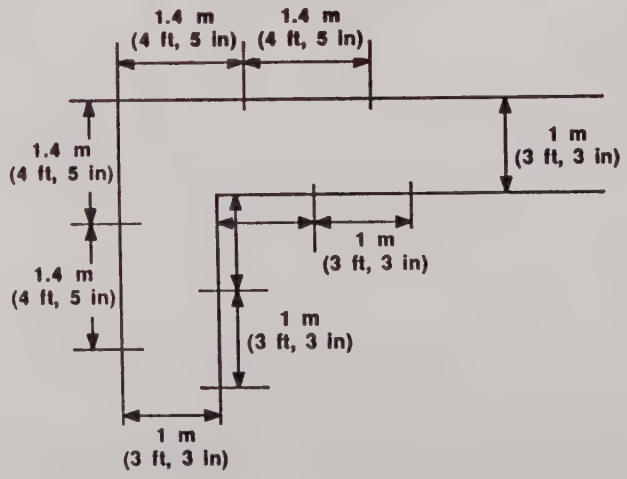
90° Turn, 1 m Spacing

Use the following procedure for turning 90° when using 1 m spacing:

1. Mark the route as though the turn was exactly 90°.



2. Measure and mark the index points.



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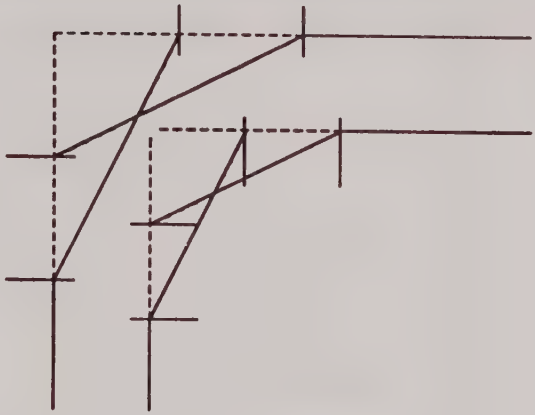
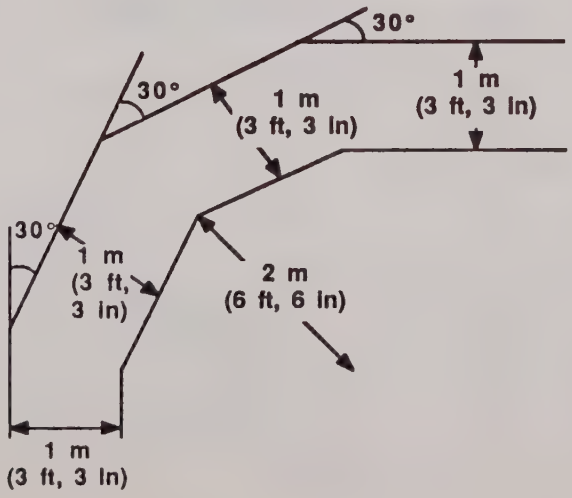
3. Mark the route shown by the index points.



4. Cut along the marked route.



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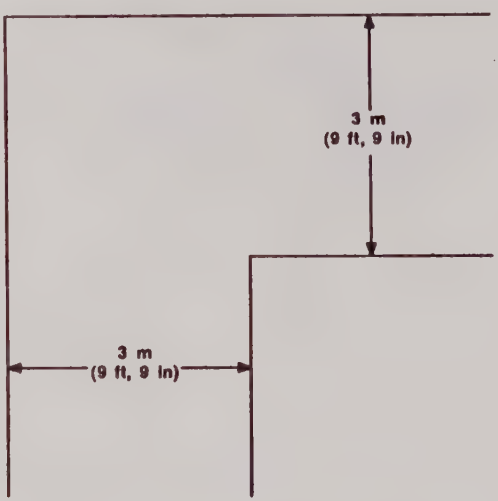
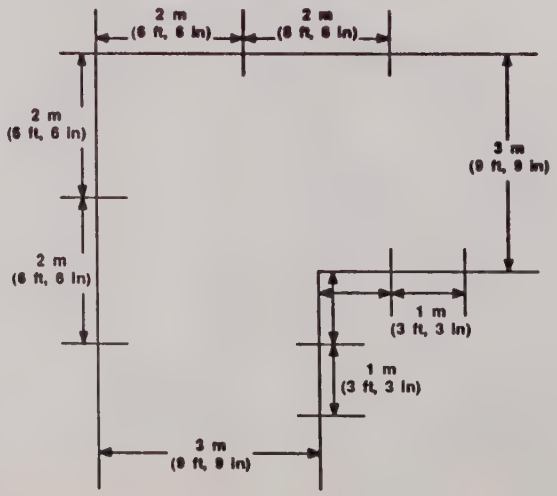
Turning 90°, 3 m Spacing

Use the following procedure for turning 90° when using 3 m spacing:

1. Mark the route as though the turn was exactly 90°.



2. Measure and mark the index points.



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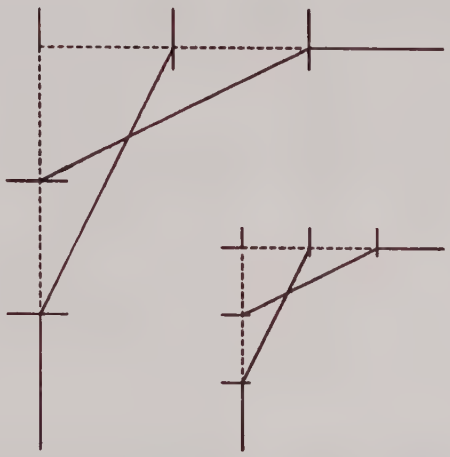
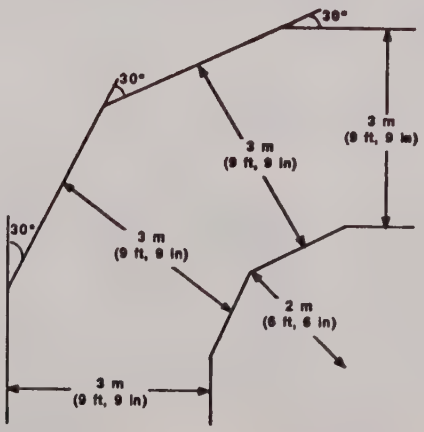
3. Mark the route shown by the index points.



4. Cut along the marked route.



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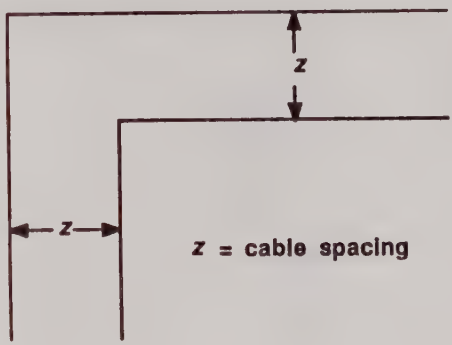
Turning 90°, Non-Standard Spacing

Use the following procedure for turning 90° when using a non-standard spacing:

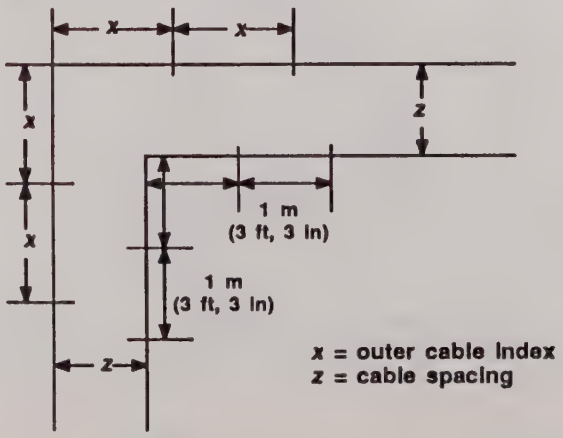
1. Mark the route as though the turn was exactly 90°.



2. Measure and mark the index points. Calculate the distance between index points of the outer cable slot by using the equation:

$$x = 1 + 0.382z$$

Where z is the cable spacing ,i.e. the distance between the cables, and x is the distance between the index points on the outer cable.



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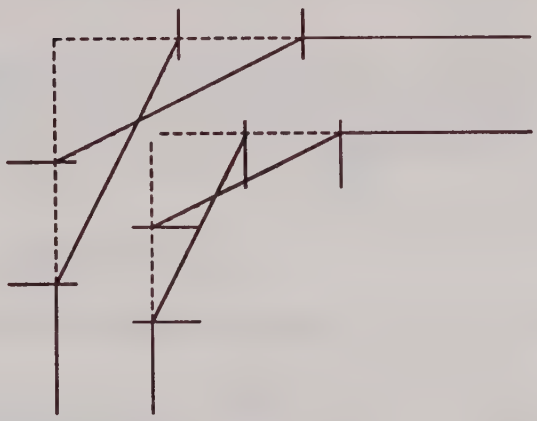
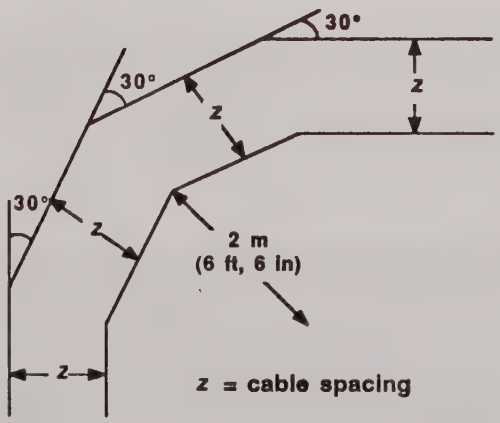
3. Mark the route shown by the index points.



4. Cut along the marked route.



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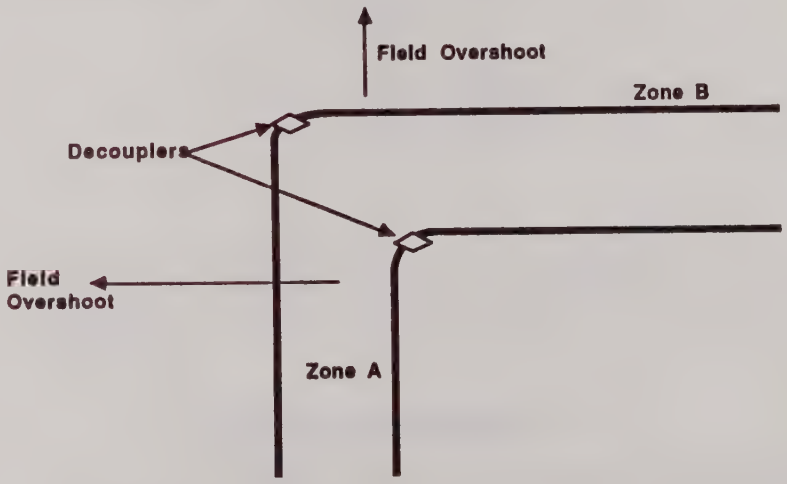
"Legal" 90° Turn

Normally you must make a 90° corner as a series of 30° turns or as a smooth curve with a minimum radius of 2 m (6 ft, 6 in). If you make the corner at a decoupler, a 90° turn is allowed.

Full field strength is maintained at the corner but the field will overshoot the corner by 2 m (6 ft, 6 in) in both directions. Make sure there are no obstacles in the path of the overshoot that could cause false alarms.



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Obstacles

Problems

Obstacles present two problems:

- the cables must be routed around them
- they may be detected by Panther

To prevent false alarms:

- Keep the cable route at least 2 m (6 ft, 6 in) from all obstacles.

False alarms are less of a problem with underground obstacles, since they do not move as readily as an above-ground obstacle. It's still a good rule of thumb to keep the cable route away from the obstacles.

Metallic Fences

Metallic fences can cause false alarms if they are in poor condition and if they move in the wind.

- Keep the cable route as far away as possible from any metallic fences, never closer than 2 m (6 ft, 6 in).
- If the fence is in poor condition, have it removed or replaced.
- If possible, make the replacement fence non-metallic.

Buildings

If the cable route ends while approaching a building wall at 90°, place the connectors for the terminators 7 m (23 ft) from the wall. This prevents the detection field from continuing through the wall and detecting the occupants moving inside. In most installations, the cables will run parallel to a wall, but never closer than 2 m (6 ft, 6 in) for the same reason.

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Water

Water in a ditch, pond, or non-metallic drainage pipe can cause sporadic false alarms as it fills and drains.

- Make sure the cables are installed in areas with good drainage.
- Make sure all drainage pipes are metallic.
- Cables routed near a building must not be under the roof drip line.

Metallic Objects

Moving metallic objects can cause false alarms. Buried metallic objects can distort the detection field and create an area of low sensitivity. For these reasons:

- Keep the sensor cables at least 4 m (13 ft) away from roads where there may be moving traffic.
- Remove visible metallic debris.
- Check for buried debris with a metal detector and remove it if necessary.

Buried Walls

Buried walls will not usually cause false alarms, but may require cable re-routing.

Under-ground Wiring

Underground wiring (electrical, phone, etc.) will not usually cause false alarms, but may require cable re-routing.

Buried Utility Pipes

Water and gas supply lines should present no problem if they are buried at least 1 m (3 ft, 3 in) deeper than the cables.

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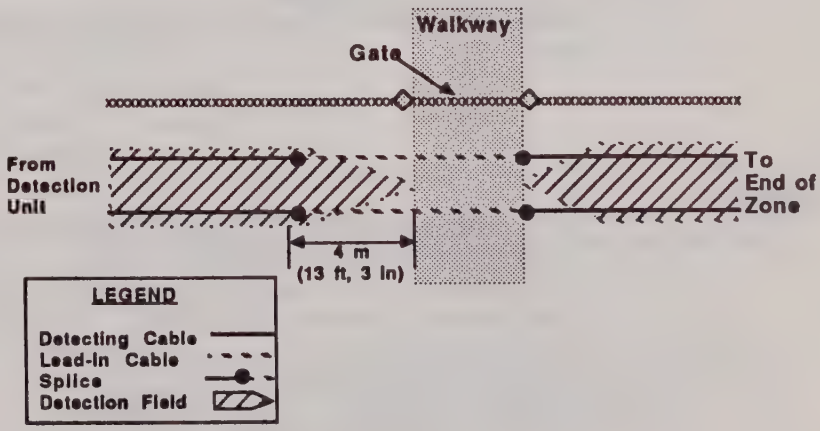
Bypass Areas

What is a Bypass?

A bypass is a non-detecting section within an active zone. It's used:

- where obstacles close to the sensor cable route cause false detection
- where an area of no detection is desired (a guarded gate, for example)
- to cross a fence boundary

A non-detecting section can be created in the middle of an active zone by splicing in lead-in cable in place of the normal transmit and receive cables.



NOTE: The detection field takes about 4 m (13 ft) to dissipate at the start of a bypass and 4 m (13 ft) to regain full strength after the end of a bypass. Make sure you allow for these two areas of partial detection in your installation design.

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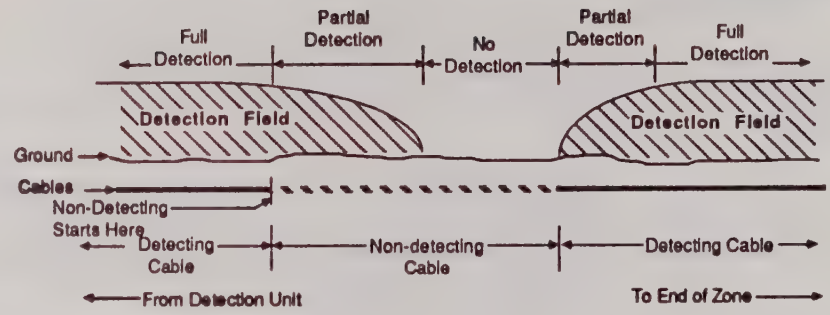

Save yourself time and money by:

- locating the detection unit so the normal lead-in sensor cable can be used for the bypass
- routing the cables so the zones end at either side of the bypass area

Tools and Equipment

To install a bypass you need:

- four male and four female Panther TNC connectors
- forty ferrite beads with retainers
- two pieces of lead-in cable, the length of the bypass
- four pieces of Panther shrink tubing
- one roll of putty tape
- one cable preparation kit
- Panther crimp tool
- Panther coaxial cable stripping tool
- side cutters
- heat gun with extension cord (in damp locations)
- ohmmeter
- female to female TNC adapter
- TNC/Banana plug adapter cable

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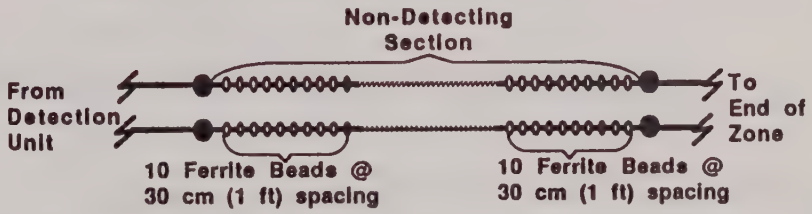
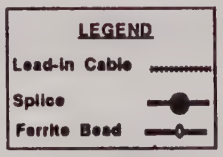
Bypass Installation Procedure

1. Cut out and discard a piece from both the transmit and receive cables which is as long as the bypass area. Do not splice in a section of lead-in cable without first removing an equal length of detecting cable at the splice location.

2. Cut the two pieces of lead-in cable approximately to length. Allow some extra length for strain relief.

3. Slide ten ferrite beads onto each end of both pieces of lead-in cable.


Non-Detecting Section
From Detection Unit
To End of Zone
10 Ferrite Beads @ 30 cm (1 ft) spacing
10 Ferrite Beads @ 30 cm (1 ft) spacing



4. Use the retainers to fasten the ferrite beads in place, 30 cm (1 ft) apart, starting 30 cm (1 ft) from the cut ends of the lead-in pieces.

5. Install connectors on one active zone cable and the corresponding lead-in piece. Use an ohmmeter and a TNC/Banana plug adapter cable to test for shorts.

6. Join the connectors, and use the putty tape and shrink tubing to waterproof the assembly.

7. Do the three remaining connections in turn.

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Preparing the Cables

Before you bury the cables you must:

- test the cables for electrical continuity
- make sure you've positively identified the non-detecting, or lead-in, section
- ensure you have enough cable for the site
- fasten the ferrite beads to the lead-in section

Each of these procedures is described on the following pages.

Continuity Test

To test the cable for continuity and shorts:

1. Open the cable caddy to access both ends of the cable. Strip both ends of the cable with the Panther stripping tool.

2. Use an ohmmeter to test the centre conductor for continuity.

3. Test the braided shield for continuity.

4. Make sure the centre conductor and the braided shield are not shorted.

Identifying Lead-in Cable

The non-detecting lead-in cable is dispensed first. If you have any doubts about the orientation of the cable, look at the stripped cable end and note the following identifying features:

- The non-detecting section has an internal foil layer.
- The detecting section does not have a foil layer.

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Unrolling the Cables

The sensor cables can be conveniently laid out along the cable route by using the following procedures:

1. Securely anchor one end of the sensor cable. Place it under a heavy rock or have someone stand on one end.
2. Hold the cable caddy in one hand and walk the cable route.
3. Make sure the non-detecting lead-in section is unrolled at the detection unit location.

Checking Cable Length

To check the cable length:

1. Lay the cables along the proposed route with the correct spacing.
2. Lay out the field-start section.
3. Do not cut the cables at this time.
4. Make sure the cables are of adequate length.
5. Make sure there is enough lead-in to reach the detection unit inside the building.

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Preparing Lead-in Cable

Attach the supplied cable identification labels to the lead-in section of each cable. Fasten ferrite beads to the non-detecting lead-in cable to prevent the detection field from straying back to the detection unit. To attach the labels and ferrite beads:

1. Make sure the non-detecting section is located closest to the detection unit.

2. Label both ends of all cables with the supplied labels.

   - TXA = Transmit cable, zone A
   - RXA = Receive cable, zone A
   - TXB = Transmit cable, zone B
   - RXB = Receive cable, zone B

3. ALWAYS make the inner cable (the one on the protected side of the perimeter) the receive (Rx) cable.

4. Keep the extra set of labels for marking the cables after they have been trimmed to length.

5. Locate the lead-in end of the cable.

6. Slide ten (10) ferrite beads onto the lead-in.

7. Use the supplied retainers to fasten the beads in place as you position them.

8. Place the first bead on the lead-in section 30 cm (1 ft) from the white ring that indicates the start of the detecting section.

9. Place the second bead on the lead-in section 60 cm (2 ft) from the white ring that marks the the start of the detecting section.

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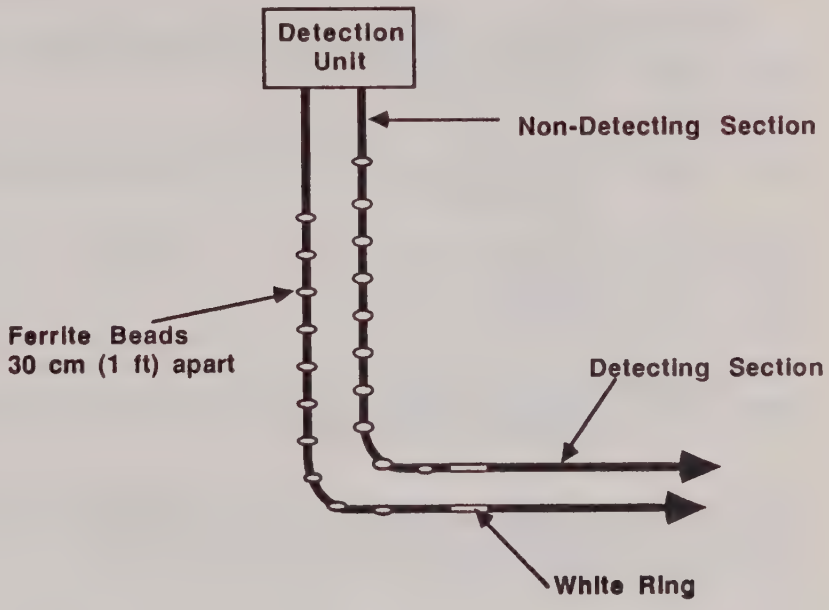
10. Place the remaining eight beads at 30 cm (1 ft) intervals down the length of the lead-in. The tenth bead should be 3 m (10 ft) from the white ring.



Inspect the outer jacket for damage along the length of the cable. The cable MUST be waterproof. If damage is detected:

- Repair the damage. See the section on splices.
- Replace cables with major damage.

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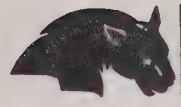

Cutting Cable Channels - An Overview

This section gives you general information about how the sensor cables are installed along the cable route.

Cable channels can be cut into four different mediums:

- soil
- gravel
- concrete
- asphalt

Soil and gravel are soft mediums; concrete and asphalt are considered to be hard mediums.

The table on the next page gives a summary of the installation methods that can be used for each medium.

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Mediums and Methods

Medium	Installation Methods
Soil	• slits cut with a sod cutter or spade
	• narrow trenches cut with a small trenching machine
Gravel	• narrow trenches cut with a small trenching machine
Concrete	• slots cut into surface with a concrete saw (cables can be covered with sealant or with sand and hot tar)
	• narrow trenches beneath concrete (concrete must not contain metal reinforcing rods)
Asphalt thicker than 15 cm (6 in)	• slots cut into surface with a concrete saw (cables can be covered with sealant or with sand and hot tar)
	• narrow trenches beneath asphalt
Asphalt thinner than 15 cm (6 in)	• narrow trenches beneath asphalt

This section provides instructions for installing cables using any of the installation methods given in the above table.

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Key Points

Wherever possible, route the cables through soil. It requires the least labor, and is the least expensive method of installation.

- Even if a zone isn't routed through soil, attempt to place the terminators or decouplers in soil.
- Make sure it's possible to bury the sensor cables at all points on perimeter.
- The sensor cables MUST be buried for Panther to work properly.
- Cables can not be placed in metal or plastic conduit. They must be in contact with the burial medium. There must be no air spaces around the cables.

Before you begin to cut cable channels, make sure you move the cables away from the work area and equipment after cable preparation. You must take every precaution against damaging the cables. Handle the cables with care when laying them into the ground.

Wherever possible, try to install one cable at a time. Cut one cable channel or slit, install the cable, restore the ground and then repeat the process for the other cable. This may not be practical when using a concrete saw, but you should use this technique for all other installations. If you try to cut the second cable channel at the same time, you may find that your equipment is continually getting caught up in the first channel.

Before you bury the cables make sure that you have:

- installed the ferrite beads, connectors and terminators or decouplers
- tested the cables for continuity

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Installing in Soil

Tools and Equipment

To install the cables in soil you will need the following tools:

- cable burial marker stakes
- flourescent marker paint
- chalk line
- shovel
- grass rake
- small trenching machine
- sod slitter or sod remover
- tools for installing connectors and terminators or decouplers (see the Making Connections and Splices section for details)
- sand (required for rocky soil)

Procedure

Install one cable at a time using the following procedure:

1. If the surface is grass covered, and the soil is not rocky, cut a 15 cm (6 in) deep slit with a sod slitter or spade. If the soil is rocky you might consider using a sod remover and a small trenching machine to dig the cable channels.

2. If the surface is bare soil, cut a slit or dig a narrow trench 15 cm (6 in) deep. If you dig a trench, put a mark on a shovel or stick 15 cm (6 in) from the end so you can tell how deep you're digging. Make sure the trench is 15 cm (6 in) deep for the whole length of the trench.

3. If you've cut slits, push the cables 15 cm (6 in) down into the slits. You can use a "push stick" (a piece of lumber 2 cm x 8 cm [1 x 4 in] with a dull end) to push the cables down. Put a mark on the push stick 15 cm (6 in) from the end so you can tell how deep you're pushing the cables down. Be very careful not to damage the cables.

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4. If you've dug narrow trenches with a machine, simply lay the cables at the bottom of the trenches and verify the depth. You can hold the cables in place at the bottom of the trench by packing small mounds of soil around the cables at intervals along the route.

5. Install the terminators or decouplers at the locations indicated on the site plan. Use the procedures given in the Making Connections and Splices section of this handbook.

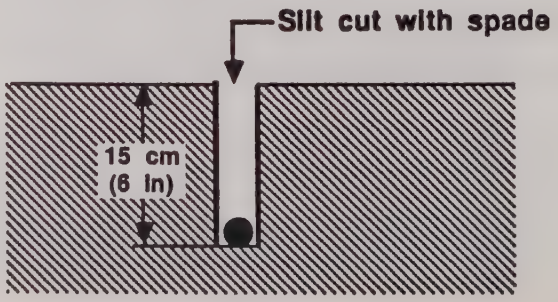
6. If you've cut slits into the soil, tamp the soil back into place. If you've dug trenches, backfill the trenches and tamp down the soil. If the soil is rocky, partially backfill with sand to protect the cables.

7. Use a grass rake to sweep the excess soil around the trenches back into the ground.

8. Restore the sod to it's original state.

9. Repeat the process for the other cable.

Make sure that each cable is buried at a uniform depth of 15 cm (6 in) for the length of each zone.



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Installing in Gravel

To provide protection from mechanical damage, cables buried in gravel must be surrounded with sand.

Tools and Equipment

- sand
- cable burial marker stakes
- flourescent marker paint
- chalk line
- shovel
- small trenching machine
- tools for installing connectors and terminators or decouplers (see the Making Connections and Splices section for details)

For burial in gravel, install one cable at a time using the following procedure:

1. Use a small trenching machine to dig a narrow trench 23 cm (9 in) deep.

2. Place an 8 cm (3 in) bed of clean sand in the bottom of the trench.

3. Lay the cable on the bed of sand. You can hold the cables in place at the bottom of the trench by packing small mounds of sand around the cables at intervals along the route.

4. Install the terminators or decouplers at the locations indicated on the site plan. Use the procedures given in the Making Connections and Splices section of this handbook.

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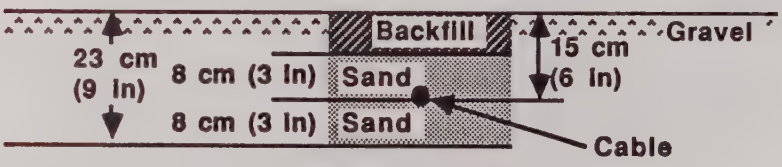
5. Cover the cable with another 8 cm (3 in) of sand.

6. Backfill to ground level.

7. Remove excess fill from the site.



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Surface Slots in Concrete/Asphalt

You can place the cables in small slots cut into the surface of a hard medium such as concrete or asphalt. If you want to cut slots in asphalt, make sure the asphalt is thicker than 15 cm (6 in). Thinner asphalt may break if slots are cut into its surface.

Because cutting with a concrete saw is a more time consuming process than digging trenches, it's recommended that both cable slots be cut before the cables are installed. However, you must take additional care to avoid damaging the cables with your equipment when using this installation technique.

Tools and Equipment

- pavement sealant (Dow Corning 888, 3M Traffic Loop Sealant)
- concrete saw
- flourescent marker paint
- chalk line
- tools for installing connectors and terminators or decouplers (see the Making Connections and Splices section for details)

For sealing with hot tar omit the pavement sealant from the above list and add:

- hot tar
- sand
- shovel

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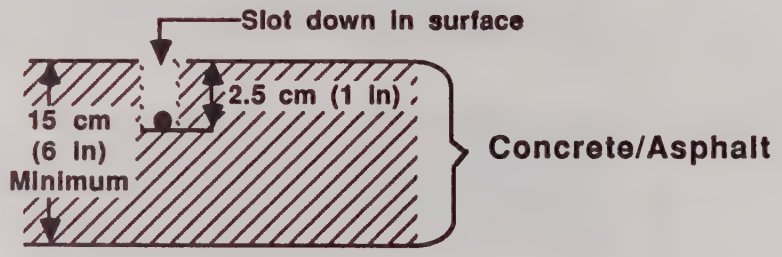
Procedure

To bury the cables in surface slots:

1. Cut two 2.5 cm (1 in) deep by 1 cm (3/8 in) wide slots into the concrete/asphalt.



2. The slots must be widened to 8 cm (3 in) for a distance of 1 m (3 ft, 3 in) wherever a terminator or decoupler is shown on the site plan.

3. Put a thin bed of Dow Corning 888, 3M Traffic Loop Sealant, or an equivalent sealant on the bottom of the slots.

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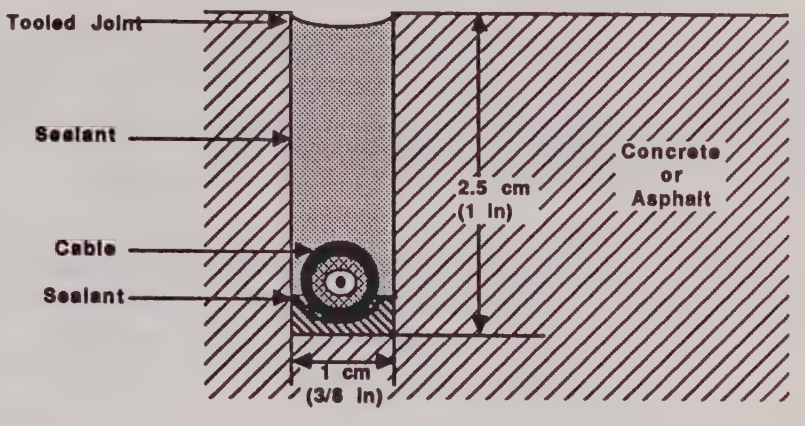
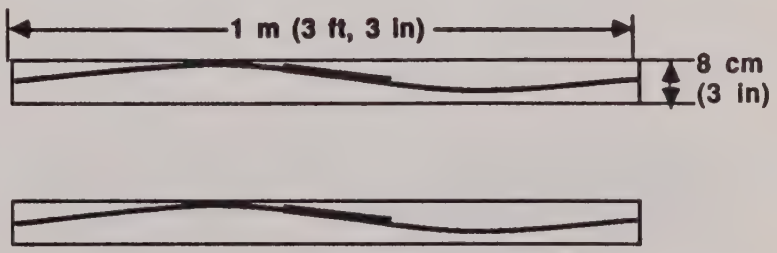
4. Lay the cable on top of the thin bed of sealant.



5. Install the terminators or decouplers at the locations indicated on the site plan. Use the procedures given in the Making Connections and Splices section of this handbook.

6. Leave some slack cable arranged in an "S" curve inside the widened slots to compensate for contraction and expansion of the cable. See the figure below.



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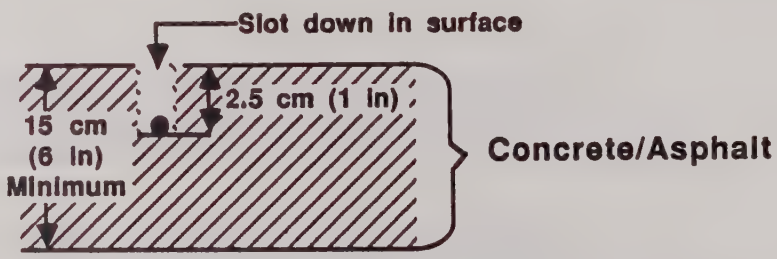
7. Cover the cable with the sealant to the concrete or asphalt surface.

Procedure for Sealing with Hot Tar

You will need all the tools and equipment required for cutting surface slots, except for the pavement sealant. Instead, substitute hot tar for the pavement sealant and add sand and a shovel to the list.

When burying the cables in concrete or asphalt, you can use hot tar as an inexpensive alternative to sealants. If you want to install the cables using hot tar, use the following procedure:

1. Cut two 2.5 cm (1 in) deep by 1 cm (3/8 in) wide slots into the concrete or asphalt.



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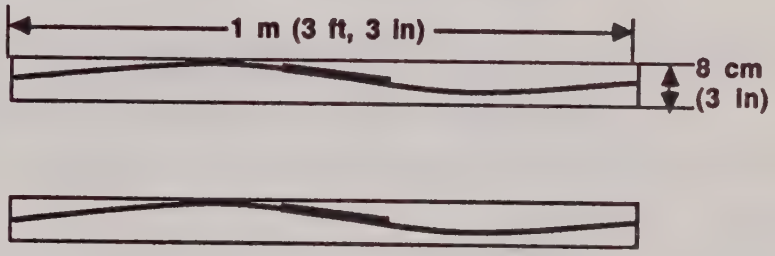
2. The slots must be widened to 8 cm (3 in) for a distance of 1 m (3 ft, 3 in) wherever a terminator or decoupler is shown on the site plan.

3. Lay the cable at the bottom of the slots.

4. Install the terminators or decouplers at the locations indicated on the site plan. Use the procedures given in the Making Connections and Splices section of this handbook.

5. Leave some slack cable inside the widened slots to compensate for contraction and expansion of the cable. See the figure below.



6. Put a 1 cm (0.4 in) layer of sand over top of the cables. The sand prevents the hot tar from melting the cable jacket.

7. Cover the cable with the hot tar. Pour the hot tar to the surface of the slot.

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Burial Beneath Concrete/Asphalt

When burying cables beneath a hard medium such as concrete or asphalt, you can either remove the concrete or asphalt and dig trenches in the soil beneath, or you can use a boring machine or "push pipe" to tunnel beneath the concrete or asphalt.

If you use a boring machine or push pipe:

- Do not go more than 30 cm (12 in) below ground level.
- Do not leave a metallic push pipe in the ground.
- Do not install the cable inside the push pipe or any other conduit.

Do not install sensor cables under reinforced concrete. The metal reinforcing rods will severely distort the detection field.

Tools and Equipment

- sand
- concrete saw
- pick axe
- cable burial marker stakes
- flourescent marker paint
- chalk line
- shovel
- small trenching machine
- tools for installing connectors and terminators or decouplers (see the Making Connections and Splices section for details)

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Procedure

If you dig trenches beneath the concrete or asphalt:

1. Use a saw to cut the concrete or asphalt.

   - To minimize the number of saw cuts, cut one wide trench for both cables.
   - To minimize the amount of restoration, cut two narrow trenches, one for each cable.

   It is diffcult to accurately place cables into trenches that are too narrow. If you use one wide trench, cut it 20 cm (6.5 in) wider than the cable spacing. If you use two narrow trenches, cut each of them 20 cm (6.5 in) wide.

2. Remove the pavement with a pick axe.

3. Use a small trenching machine to dig a trench 31 cm (12 in) deep.

4. Place an 8 cm (3 in) bed of clean sand in the bottom of the trench.

4. Lay the cable on the bed of sand.

5. Install the terminators or decouplers at the locations indicated on the site plan. Use the procedures given in the Making Connections and Splices section of this handbook.

6. Cover the cable with another 8 cm (3 in) of sand.

7. Backfill as needed, and restore the concrete/asphalt surface.

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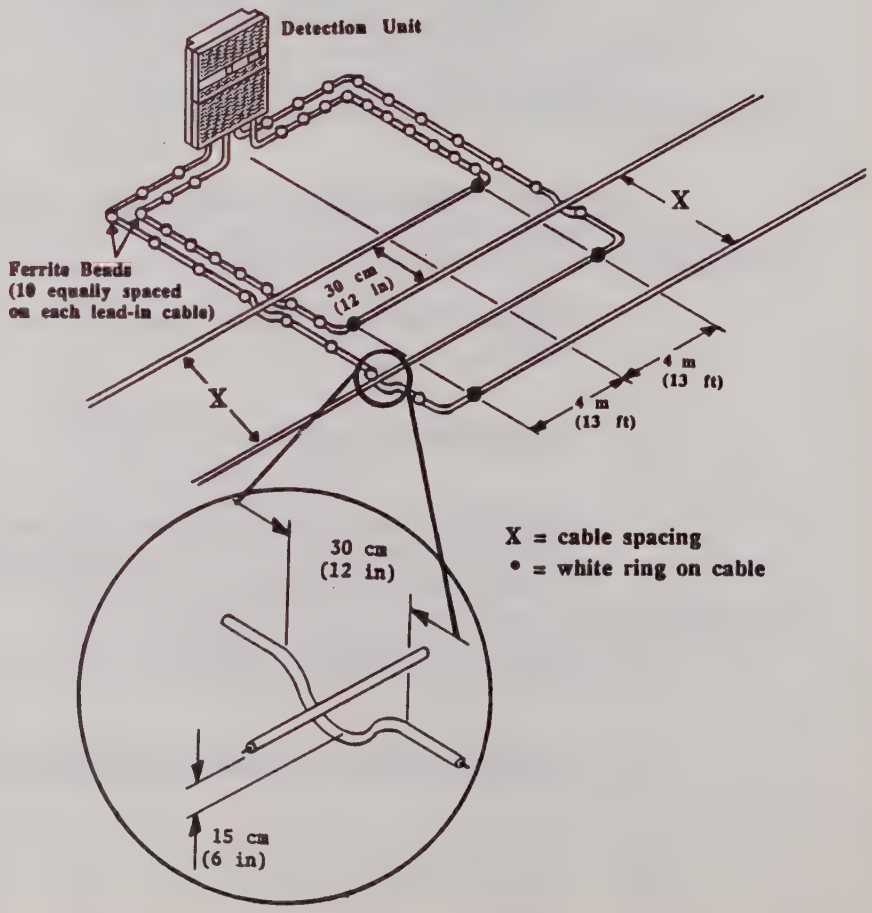
Installing an Overlap

If you're installing a two-zone decoupled system, make sure the sensor cables are properly laid out in the field-start overlap area. This overlap area:

- allows the detection field in each zone to build to full strength
- provides overlapping, full strength coverage



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Running Lead-in Cable Indoors

Make sure you've found a suitable location for the detection unit before you run the lead-in cable inside the customer's building. Lead-in cable is non-detecting cable so you can place it inside conduit without affecting the operation of the system. Conduit will help you pass the cables through the building, but it's not essential that you use it.

Tools and Equipment

- wood drill
- concrete drill (if required)
- conduit
- electrical tape
- fish tape (if required)
- tacking gun or cable tacks

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Procedure

To pass the lead-in cable through the customer's building to the detection unit, use the following procedure:

1. Locate and mark the desired entrance area.

2. Drill a hole large enough for six sensor cables.

3. Install exterior conduit if desired.

4. Install interior conduit if desired.

5. Tape the ends of the four sensor cables together.

6. If required, feed the fish tape from the detection unit to the exterior. Fasten the sensor cables to the fish tape.

7. Feed the sensor cables to the interior.

8. Route the sensor cables to the detection unit location using the wood drill where necessary and install cable tacks where required. If you accidentally pierce the cable jacket, repair it immediately using the recommended procedure in the Making Connections and Splices section of this handbook.

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Installing the Detection Unit

Mounting the Detection Unit

Connecting Other Devices

Using the Terminal Strip

Installing Supervision Resistors

Setting Options

Final Connections

Mounting the Detection Unit

The detection unit must be mounted indoors, inside the customer's building. Make sure that:

- the temperature stays within the range 0°-50°C (32°-122°F)
- 12 Vdc ±15% @ 750 ma power is available

Tools and Equipment

- load set (for a single-zone system only)
- drill with extension cord
- screwdriver
- tools for installing connectors (see the Making Connections and Splices section)
- a copper ground rod 1 cm (3/8 in) in diameter and at least 1.2 m (4 ft) long

Procedure

1. Unpack the detection unit pieces from the shipping carton. Don't assemble the pieces yet. Make sure you have:

   - the detection unit housing
   - the electronics module
   - the terminal connection module
   - 15 m (49 ft) of #16 ground wire with a female terminal on one end
   - the parts kit

2. The wiring can run into the housing through the knockouts on the bottom or the back of the housing. The remainder of this procedure describes an installation using the bottom knockouts.

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3. Locate the two knockouts on the bottom of the housing. Each knockout has two sections, an inner one for creating a small hole, and an outer one for creating a large hole. Remove both sections of the left knockout. This leave a large hole. Remove only the inner section of the right knocknout. This leaves a small hole. Fasten the bushings from the parts kit to the holes. The large bushing is for the sensor cables. The small bushing is for the alarm panel connections and any other wiring.

4. Hold the detection unit housing against the wall in its intended location and mark the upper mounting holes. Set the housing aside.

5. Drill holes for the top two mounting screws. The screw package in the parts kit includes masonry anchors and a drill-size chart.

6. Install the screws, but leave them projecting 3 mm (0.118 in) out from the wall. Use the supplied anchors, if necessary. Hang the detection unit housing on the screws.

7. Mark the locations of the bottom holes on the wall and remove the housing. Drill holes for the bottom two screws.

8. Rehang the housing, install the bottom screws, and tighten all four screws.

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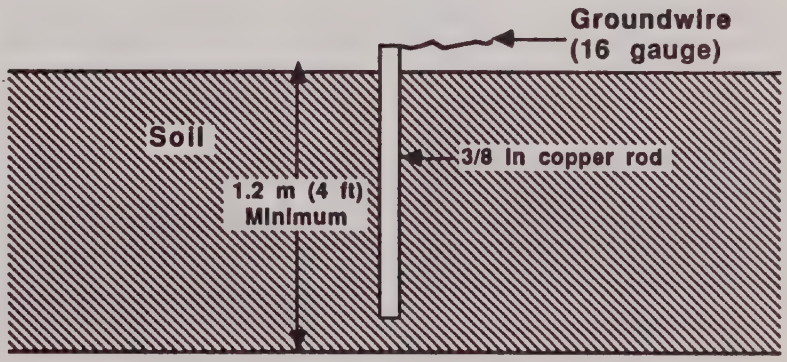
9. The detection unit must be adequately grounded to allow its lightning protection components to function properly. Follow these rules:

   - Use buried ground rods (earth ground).
   - Don't use the utility (hydro) or ac or dc grounds.
   - Use the #16 ground wire supplied with the detection unit.
   - Keep the ground wire as short and direct as possible. Avoid loops or turns.
   - Avoid induced currents. Keep the ground wire away from other cables or wires, especially the lead-ins from outdoor antenna wires.

Feed the ground wire through the small bushing and push the female connector onto one of the three ground terminals inside the housing.



10. Snap the electronics module into place. See the How Panther Works section for details.

11. Connect the ground wire from the electronics module to one of the three ground terminals inside the housing.

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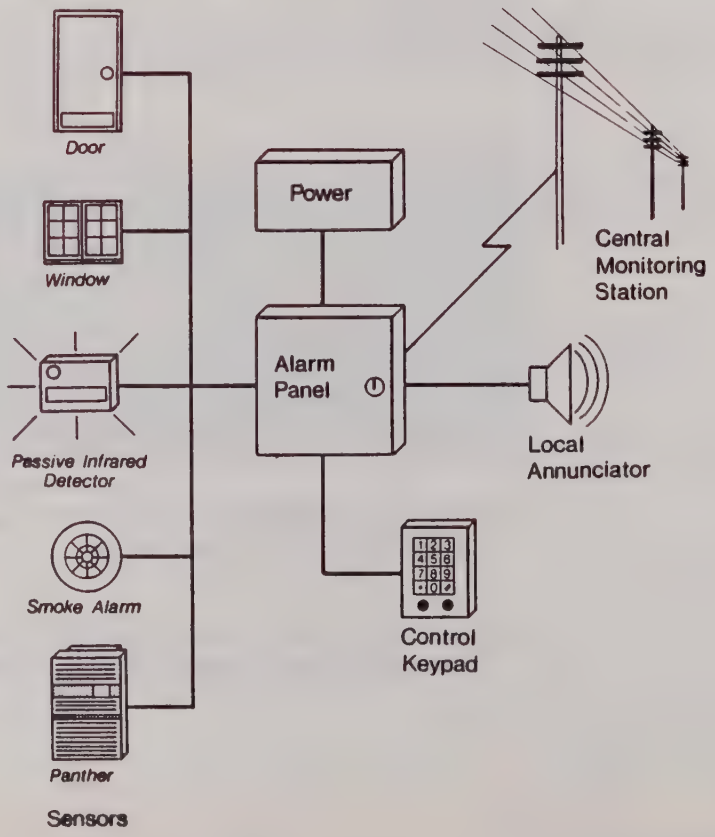
Connecting Other Devices

For proper operation, Panther requires:

- a 12 Vdc 750 mA power supply (with battery backup if required)
- an alarm panel or annunciator

In addition to the required devices, Panther can also work in conjunction with other types of sensors and other devices commonly used in security systems.



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Terminal Connection Module

All connections to other devices are made via Panther's terminal connection module.

The terminal connection module has:

- an eighteen-position terminal strip for external connections
- twelve supervision resistor mounting sockets
- a ten-position option selection switch
- a replaceable power supply fuse (3/4 A fast blow 3AG type; Littlefuse P/N 312.750, Buss P/N AGC 3/4 A, or equivalent)
- spare fuse

Alarm Panels

If the site you're installing requires alarm processing capabilities, you will have to connect Panther to an alarm panel.

Panther is designed to interface easily with a wide variety of alarm panels. There are many different ways that Panther can be connected to an alarm panel.

Alarm panels are connected to the terminal strip on the terminal connection module. If your alarm panel requires supervision (end-of-line) resistors, you can plug resistors into the sockets located on the terminal connection module. The next two sections tell you how to use the terminal strip and the supervision resistor sockets.

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Alarm Types

Panther generates two types of alarms:

- intrusion
- warning

Intrusion alarms occur whenever someone crosses the cables. This type of alarm is output at the Alarm A and Alarm B terminals on the terminal strip.

Warning alarms occur whenever a system fault is detected or when someone opens Panther's top door. This type of alarm is output at the Warning terminals on the terminal strip. However, you can change the way warning alarms are output by using the option selection switch. See the Setting Options section for more information.

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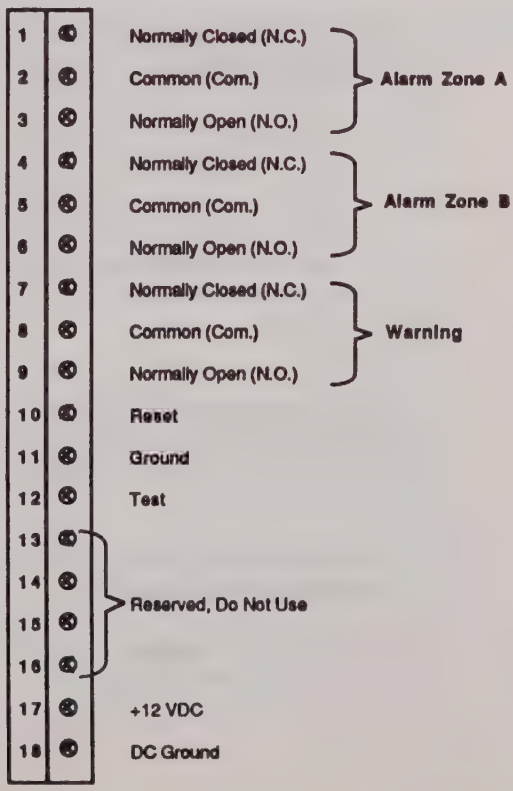
Using the Terminal Strip

The terminal strip provides connections for:

- zone A alarm form C relay output
- zone B alarm form C relay output
- warning alarm form C relay output
- a remote reset line
- a remote test line
- the 12 Vdc power supply input

The unassigned terminals are reserved for future expansion and must not be used.



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Panther provides three alarm outputs:

- zone A alarm
- zone B alarm
- warning alarm

Each of the outputs has a form C relay with the following connections:

- normally closed (N.C.)
- common
- normally open (N.O.)

Note the following electrical characteristics:

- Each alarm output is rated for an 8VA resistive load. DO NOT exceed either 100 Vdc or 0.25 A.
- Each alarm output is completely isolated from all of the others. In particular, the common leads are not tied together.
- To provide fail-safe operation, the relays are energized under normal conditions. Loss of power causes an alarm condition. The N.C. and N.O. designations refer to the state of the relays under normal (no alarm) conditions when power is on.
- Supervision resistors can be inserted into the output circuitry by using the supervision resistor sockets (see the next section).

Panther provides remote Test and Reset terminals. To activate either one of these features, connect the appropriate terminal to the common ground (terminal #11).

To activate the Test or Reset function, the connection to the common ground must:

- have a total resistance of less than 600 Ω
- last for at least 30 ms

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Making Connections

To make connections to the terminal strip, perform the following procedure:

1. Feed the power and signal lines into the detection unit through the small bushing.

2. Unpack the terminal connection module.

3. Install supervision resistors, if required. See the Installing Supervision Resistors section for more information.

4. Connect the power and signal lines to the terminal strip.

5. Align the four holes at the corners of the terminal connection module with the four standoffs mounted in the lower right section of the housing. Push firmly into place.

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Installing Supervision Resistors

What are they for?

Supervision (end-of-line) resistors are used to provide an extra level of security in some alarm systems. Supervision resistors are recommended for installations where the signal lines connecting Panther to the central alarm panel are vulnerable to damage or sabotage.

Panther doesn't require any supervision resistors for proper operation. However, the alarm panel you're using may require supervision resistors for all sensor lines. If you need to install supervision resistors, determine the values for these resistors from the instructions packaged with the alarm panel.

How Do They Work?

The basic idea behind supervision is to provide a known, fixed resistance on an alarm line for the alarm panel electronics to measure. A change in the resistance indicates one of the following:

- an alarm condition has been detected, and a relay contact has closed
- the line has failed
- someone has cut the line
- someone has shorted the line

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Supervision Resistor Schemes

There are several supervision schemes. Simple schemes can provide a way to detect one of the conditions listed above and raise an alarm. More complex supervision schemes can differentiate between all of the conditions and provide more information to security personnel.

The schemes are classified as:

- single resistor schemes (in series or parallel)
- dual resistor schemes (in series and parallel)

Since each alarm provides both a N.O. and a N.C. contact, there are four useful variations:

- N.O. single resistor parallel
- N.C. single resistor series
- N.O. dual resistor
- N.C. dual resistor

Two less useful variations are:

- N.O. single resistor in series
- N.C. single resistor in parallel

The less useful variations are not normally used. The first cannot detect an open line fault. The second cannot detect a shorted line fault.

The simple diagrams on the next page show how the various supervision schemes are wired and the kinds of faults they can detect.

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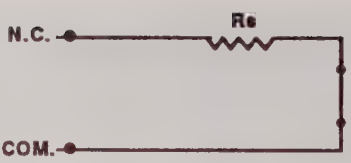
Single Resistor, in Series, Normally Closed

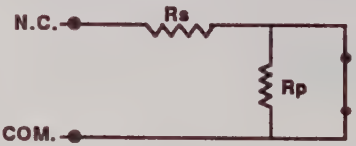


Possible Values	Meaning
Rs	Normal
0 ohms	Line shorted
Infinite	Alarm or line open

Single Resistor, in Parallel, Normally Open

Possible Values	Meaning
Rp	Normal
0 ohms	Alarm or line shorted
Infinite	Line open

Dual Resistor, Normally Closed

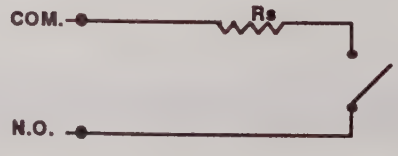


Possible Values	Meaning
Rs	Normal
Rs + Rp	Alarm
0 ohms	Line shorted
Infinite	Line open

Dual Resistor, Normally Open

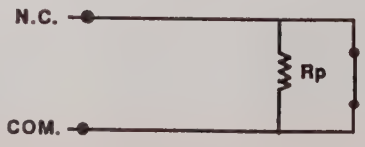
Possible Values	Meaning
Rs + Rp	Normal
Rs	Alarm
0 ohms	Line shorted
Infinite	Line open

Single Resistor, in Series, Normally Open



Possible Values	Meaning
Infinite	Normal or line open
Rs	Alarm
0 ohms	Line shorted

Single Resistor, in Parallel, Normally Closed



Possible Values	Meaning
0 ohms	Normal or line shorted
Rp	Alarm
Infinite	Line open

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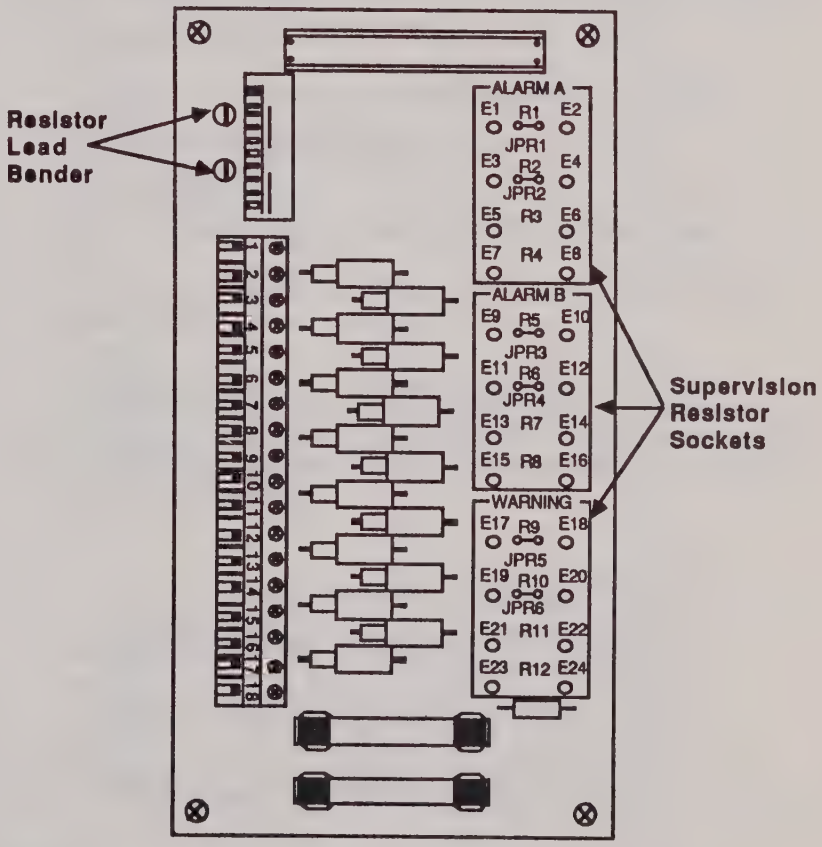
Using the Sockets

The terminal connection module has solderless sockets designed to accept supervision resistors. The sockets are part of the circuitry for the alarm outputs on the terminal strip. There are four sockets provided for each of the three alarm outputs. The sockets are labelled R1, R2, ..., R12.



Since supervision resistors aren't required for normal operation, the series resistor sockets (R1, R2, R5, R6, R9, R10) are shorted with wire jumpers at the factory. Before you insert a resistor into one of these sockets, clip out the wire jumper. These sockets must be filled with either jumpers or resistors. Do not leave them empty. Use the resistor lead bender mounted on the module to simplify resistor installation

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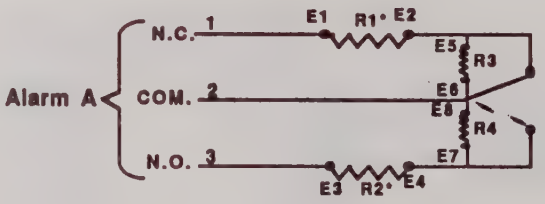
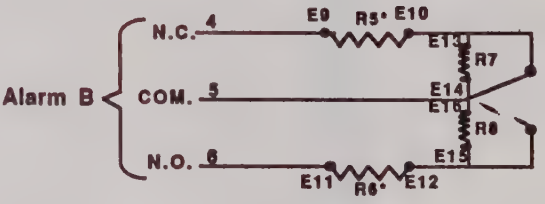
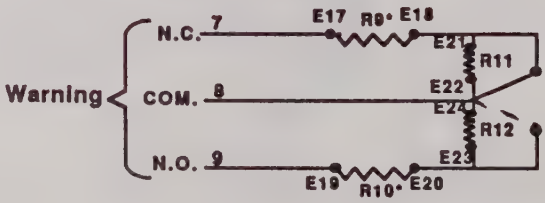
The simple schematics below can help you determine which sockets to fill for your supervision scheme. Obtain the values of the resistors from the instructions provided with the alarm panel you are using.







* If not present, replace with a jumper

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Setting Options

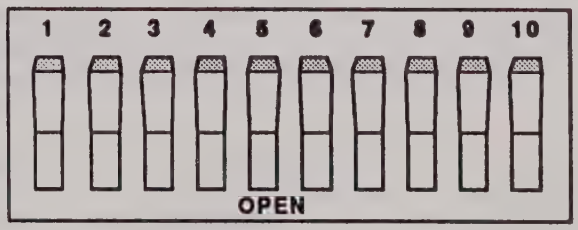
You can change Panther's analog and alarm outputs by using the option selection switch located on the terminal connection module.

Option Selection Switch

The option selection switch allows you to:

- combine alarm types
- enable or disable warning alarms associated with Panther's top door
- determine the type of analog output coming from Panther's Output jacks

The standard settings for the ten-position option selection switch are shown in the illustration below. Note that all switches are set to the OPEN position when the terminal connection module is shipped from the factory.



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Switch Functions

The function of each switch on the option selection switch is shown in the table below.

Switch	Position	Function
1	always Open	RESERVED
2, 3 and 4	2 3 4	OUTPUT SELECTION
(O = Open)	O O O	sensor output
(C = Closed)	O O C	clutter output
	O C O	threshold output
	O C C	1 V reference output
	C O O	I/Q output
	C O C	ramp output
	C C O	RESERVED
	C C C	RESERVED
5	Open	Warning alarms are annunciated independently from intrusion alarms
	Closed	Warning alarms are included with intrusion alarms
6	Open	Tamper switch is enabled
	Closed	Tamper switch is disabled
7	always Open	RESERVED
8	always Open	RESERVED
9	always Open	RESERVED
10	always Open	RESERVED

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Combining Alarms

Panther generates two kinds of alarms:

- intrusion alarms that are generated when the detection field is disturbed
- warning alarms that occur whenever Panther's door is opened or a system fault is detected

Switch 5 makes a warning alarm equal to an intrusion alarm. In other words, the same kind of alarm is generated whether the door is opened or a system fault is detected or an intrusion is detected. This feature is supplied so a warning alarm can be annunciated even if you haven't used a warning alarm output on the Panther terminal strip. When switch 5 is closed, a warning alarm is output at the Alarm A and Alarm B terminals.

Enabling/ Disabling Tamper Alarm

Switch 6 disables the warning alarms generated by the tamper switch. This feature is especially useful during commissioning activities where you wish to operate Panther with the detection unit door open.

Selecting Analog Output

Switches 2, 3 and 4 select the type of analog output provided by the Output jacks on the Panther front panel. These switches are for commissioning the system. For more information on how to use these switches, see the Commissioning section.

Reserved Switches

Switches 1, 7, 8, 9, and 10 of the option selection switch are reserved for future use must always be left in the OPEN position.

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Final Connections

Once you've installed any required supervision resistors, made all of your connections to the terminal strip and set the option selection switch, you can finish installing the detection unit by carrying out the following procedure:

1. Align the four holes at the corners of the terminal connection module with the four standoffs mounted in the lower right section of the housing. Push the terminal connection module firmly into place.

2. Attach the ribbon cable to the electronics module. Ensure that the retention clips at each end of the connector are fastened.

3. Feed the lead-in cables into the detection unit through the large bushing.

4. Before you cut the cables to length:

   - leave a 2 m (6 ft, 6 in) coil as a service loop in an inconspicuous location outside the housing
   - re-label the cables if trimming them to length will cut off the existing labels

5. Install the TNC male connectors on the sensor cables. For detailed instructions see the Installing Connectors section.

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6. Measure the resistance between the headshell and center pin of each connector. It should be 130 kΩ, which is the value of the sensor cable supervision resistor in the terminator/decoupler.

7. Connect the sensor cables to the electronics module.

8. If this is a single zone system, attach loads from the load set to the unused zone connectors on the electronics module.

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Commissioning

About Commissioning

Interpreting Panther's Output

Initial Testing

Setting Up a Chart Recorder

Setting Sensitivity

Improving Sensitivity

Finishing Up

Customer Acceptance Testing

About Commissioning

Your Goal

The goal of commissioning is to ensure that:

- all connections are correct
- sensitivity is properly adjusted

If the sensitivity is set too low, intruders may escape detection.

If the sensitivity is set too high, false alarms will be generated.

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Interpreting Panther's Output

Lights and Relays

The alarm lights and alarm output relays are two-state devices -- they are either on or off.

When an intruder is detected, Panther illuminates an alarm light and closes the corresponding relay.

When no intruders are detected, the alarm lights are off and the alarm relays are open.

The alarm lights and alarm output relays are unlatched -- as soon as the triggering condition is removed, the lights go off and the relays open. Alarm latching must be provided by the alarm panel.

Detection Meter

The detection meter is an analog device. The readings it produces range from -50 (low) to +50 (high), with zero at the center of the scale.

The deflection of the detection meter directly corresponds to the size of the disturbance in the detection field. For example, a bird generates a small deflection while a adult human generates a large deflection.

When no intruders are present, the meter indicates a low value. As an intruder approaches the detection field, the meter reading rises. A zero reading, at the center of the scale, corresponds to the alarm trip point. If the reading rises to zero or goes above it, Panther declares an intrusion alarm. It illuminates the alarm light and closes the relay to signal the alarm condition.

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Analog Outputs

The analog outputs, Output A and Output B, produce a dc voltage which can range from -2.5Vdc (low) to +2.5Vdc (high). The voltage directly corresponds to the size of the disturbance in the detection field. In fact, the analog outputs and the detection meter readings correspond directly as shown in the table below.

Detection Meter Reading		Voltage Level (Vdc)	
50		2.5	
40		2.0	
30		1.5	Alarm
20		1.0	
10		0.5	
0	<- Alarm Trip Point ->	0	
-10		-0.5	
-20		-1.0	No
-30		-1.5	Alarm
-40		-2.0	
-50		-2.5	

The analog outputs allow you to connect a chart recorder to Panther's detection unit. The strip chart produced by the chart recorder provide you with a permanent record of sensitivity levels along the length of the perimeter.

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Converting Output Readings

To convert a reading on the detection meter to a equivalent analog output voltage, divide the value on the meter by twenty (20). Some examples:

+30 units + 20 = +1.5 Vdc
-18 units + 20 = -0.9 Vdc
0 units + 20 = 0 Vdc

To convert an analog output voltage to the corresponding reading on the detection meter, multiply by twenty (20). Some examples:

+1.5 Vdc x 20 = 30 units
-1.5 Vdc x 20 = -30 units
-2.0 Vdc x 20 = -40 units

For the alarm lights and relays:

- any negative voltage = no intrusion alarm, lights and relays off
- any positive voltage (including zero volts) = intrusion alarm, appropriate light and relay on

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Initial Testing

Functional Test

Perform the following test to make sure all connections have been made properly. This test will also help you confirm that the detection electronics are working normally.

1. Before you apply power, check the following:

   - adequate ground installed using copper ground rod
   - power connection polarity correct
   - sensor cables attached
   - load kit attached, if necessary
   - alarm circuit temporarily disconnected
   - ribbon cable is attached firmly
   - option selection switch set correctly
   - detection meter shows a reading of "0" (use screwdriver adjustment, if necessary)

2. Leave both doors open. Apply 12 Vdc power and make sure Panther's Power and Warning lights are on. (Note: if switch 5 is closed, the Warning light won't come on.) The Alarm A and Alarm B lights should come on briefly.

3. Set the Zone switch to the "A" position.

4. Slide the Sensitivity A control to "0".

   - The detection meter should show a reading in the green area.
   - The Alarm A light should be off.

5. Slide the Sensitivity A control to "100".

   - The detection meter should show a reading in the red area.
   - The Alarm A light should be on.

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6. Slide the Sensitivity A control to the point where the detection meter goes below -10, and leave the control there as an initial setting.

7. Set the Zone switch to the "B" position.

8. Repeat steps 4 to 6 using the Sensitivity B control.

If any of the above steps fails, check your connections again and make sure nothing is loose. Repeat the test. If the detection unit is still not operating properly, replace the detection electronics module and repeat the tests again.

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Setting Up a Chart Recorder

Panther's sensitivity is initially set using a strip chart recorder. The chart recorder is connected to the Output A and Output B jacks. The recorder provides a permanent record of Panther's sensitivity along the length of each zone. The chart recorder also makes it possible for one person to perform initial calibration and adjustment.

Dual-Channel Advantages

You can easily do a calibration by using a single-channel chart recorder, but a dual-channel chart recorder has some advantages:

- You can check for zone overlap in a two-zone decoupled system.
- You can observe the sensitivity of two zones simultaneously.
- You can save time.

Necessary Features

Whichever type of strip chart recorder you use, it must have the following features:

- rate adjustable from 25 to 50 mm/min (1 to 2 in/min)
- zero Vdc center scale
- range -2.5 Vdc to +2.5 Vdc

Examples:

- Gould Model 220, dual-channel recorder
- Graphtec Model WR7500-2, dual-channel recorder
- Hioki Model 8201, compact single-channel recorder

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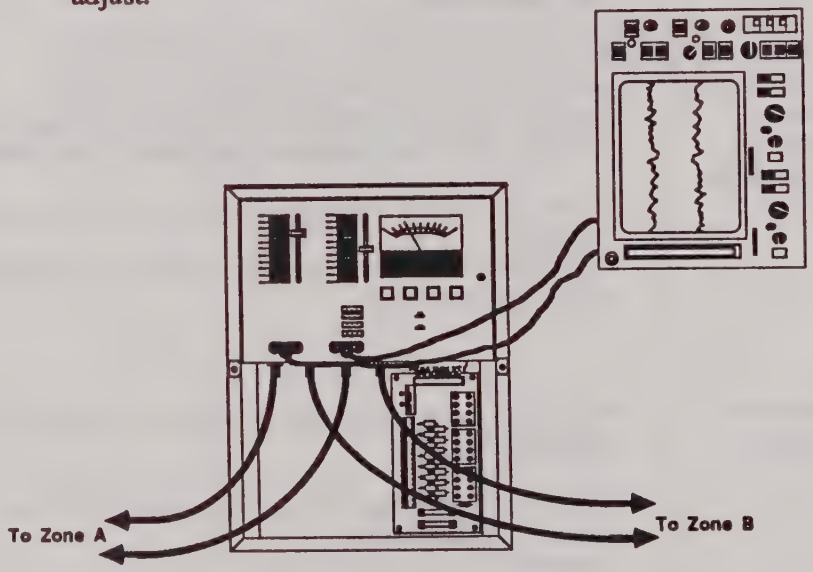
Set Up Procedure

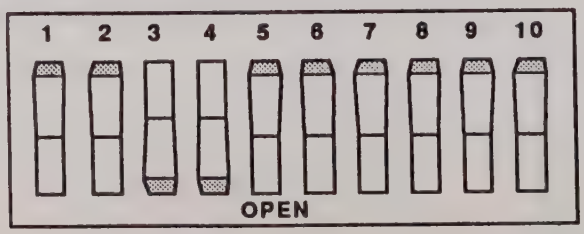
To set up the strip chart recorder :

1. Turn on the strip chart recorder and set the speed to 25 mm/min (1 in/min). Set the zero adjust (or offset) so that 0 Vdc is at center scale. Set the range to -2.5 Vdc to +2.5 Vdc.

2. Use dual banana-plug patch cords to connect the strip chart recorder to the Output jack(s) of the zone(s) you want to adjust.



3. Panther can generate a +1.0 Vdc output that you can use to check your chart recorder. To obtain the +1.0 Vdc reference voltage, set option selection switch 3 and 4 to the closed position. The reference voltage appears on both the A and B outputs.



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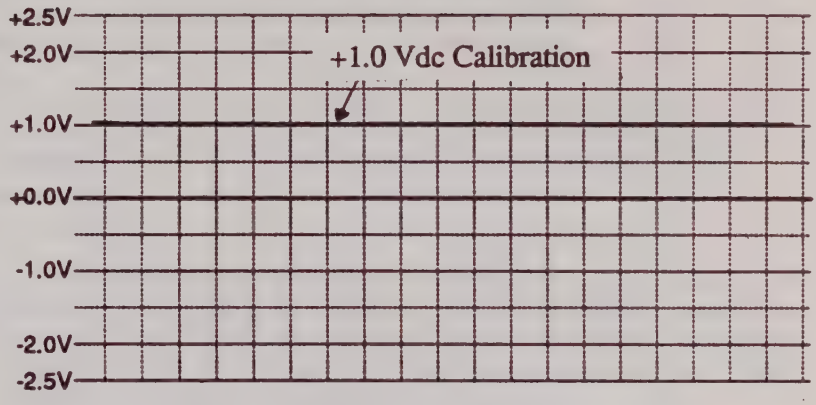
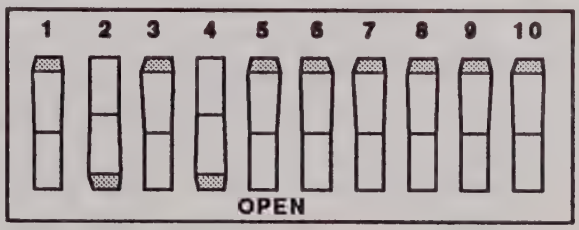
4. Adjust the strip chart recorder so that it registers +1.0 Vdc.



5. Reset option selection switches 3 and 4 back to the open position.

6. Pull out the connector(s) from the Output jack(s). The chart recorder should show a reading of 0.0 Vdc. If it doesn't, readjust or replace the chart recorder.

7. Panther can generate a ramp output (-2.5 Vdc to +2.5 Vdc) that you can use to check your chart recorder. To obtain the ramp output, set option selection switches 2 and 4 to the closed position. The ramp output is not the same for output A and B.



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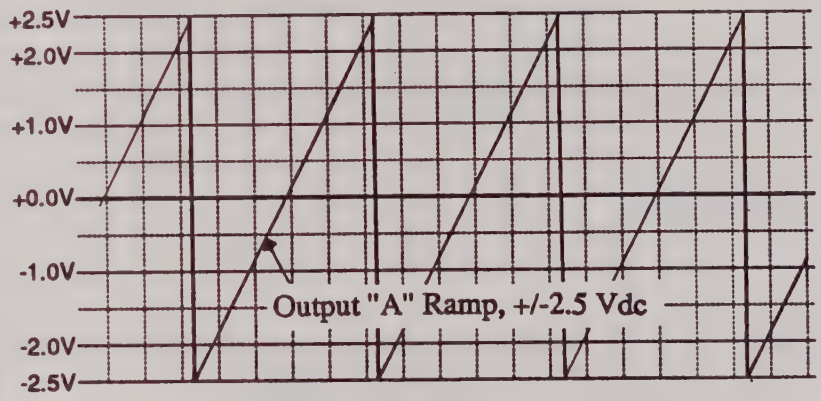
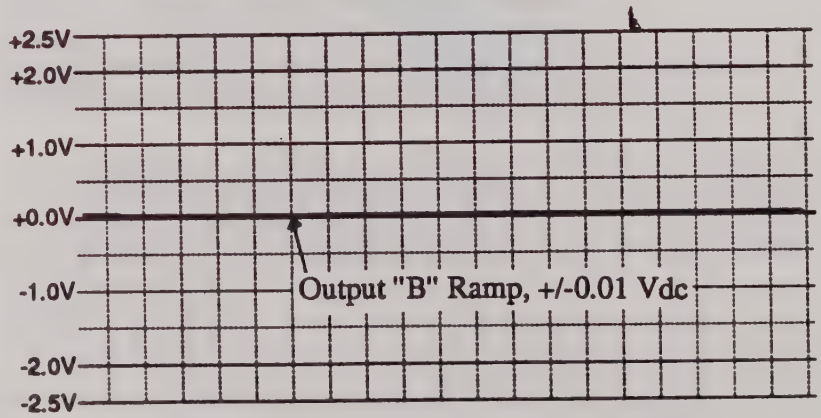
8. The ramp output from analog output A appears as shown in the figure below. The output extends from -2.5 Vdc to +2.5 Vdc on the chart recording of zone A. If it doesn't, adjust your chart recorder so that the proper range is registered.



9. The ramp from analog output B extends from -0.01 Vdc to +0.01 Vdc. This appears as a straight line if the strip chart range is set to -2.5 Vdc to +2.5 Vdc. If you are checking a dual-channel recorder, use the analog A output (-2.5 Vdc to +2.5 Vdc) to calibrate both channels.



10. If you're unable to achieve a proper ramp output, replace the chart recorder.

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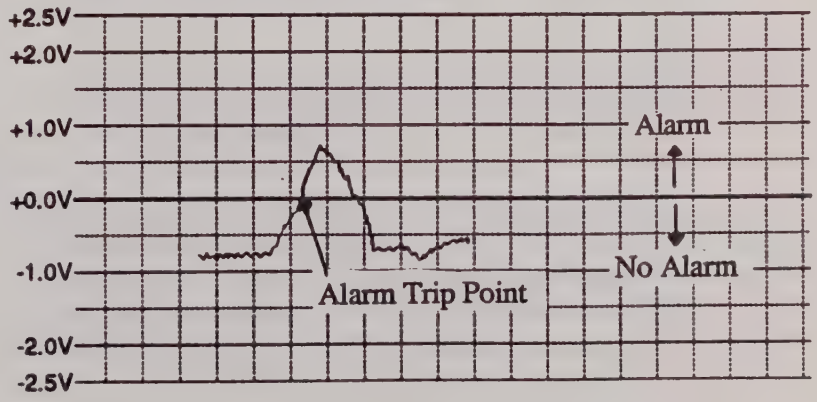
Setting Sensitivity

The voltage levels you observe on the chart recorder allow you to set Panther's sensitivity controls so that alarms are generated when a 70 kg (154 lb) adult human being crosses the cables.

Alarm Trip Point

The alarm "trip point" is at 0.0 Vdc for each zone. When you're moving the sensitivity control, it is helpful to imagine that you're moving the strip chart trace up and down relative to the trip point. When you adjust a sensitivity control, you're actually adding a dc offset voltage to the analog output.

When no one is moving inside the detection field, Panther generates negative voltage levels. As an intruder approaches the detection field, Panther generates more positive (or higher) voltage levels. Panther closes an alarm relay and turns on the alarm light whenever it detects a positive voltage level (0.0 Vdc or higher).



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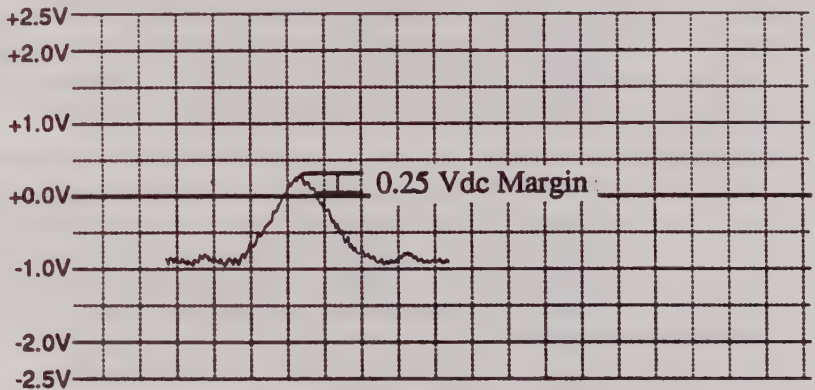
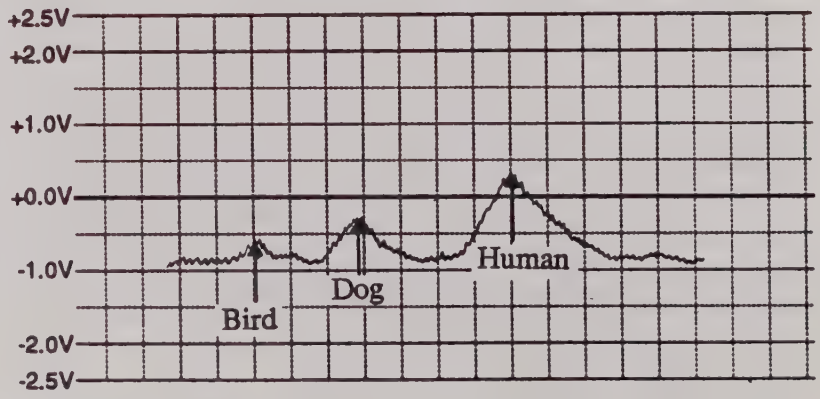
Optimizing Detection

For optimum detection, set Panther's sensitivity controls so a 70 kg (154 lb) adult human crossing the detection field generates an analog output of +0.25 Vdc.

This +0.25 Vdc margin above the "trip point" sets the sensitivity high enough to detect human intruders while eliminating false alarms caused by small animals and birds. The first chart recording below shows the +0.25 Vdc margin. The second chart recording shows how disturbances created by birds, dogs and humans compare when the sensitivity is set using this technique.





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Key Points

Remember:

1. Although voltage levels may vary within a zone, they must average between +0.25 Vdc and +0.5 Vdc for the length of the zone.

2. The lowest acceptable voltage level in any zone is +0.10 Vdc. See the Improving Sensitivity section of this chapter if you can't eliminate voltage levels lower than +0.10 Vdc.

3. The highest acceptable voltage level in any zone is +1.0 Vdc. Levels higher than +1.0 Vdc increase the likelihood of false alarms. See the Improving Sensitivity section if you have large areas with levels higher than +0.5 Vdc.

The Procedure

Adjust each zone independently as follows:

1. Connect the strip chart recorder to the Output jacks and set it up as described above. If there is only one zone connected to the detection unit, connect a load set to the TX and RX connectors of the unused zone.

2. Set the sensitivity control of the zone so that the chart recorder traces -0.5 Vdc or the detection meter shows a reading of -10 units.

3. The sensitivity should be adjusted to detect a 70 kg (154 lb) human. If the person doing the walk test weighs significantly more, the sensitivity will be set too low. The description below assumes you are doing the walk test yourself.

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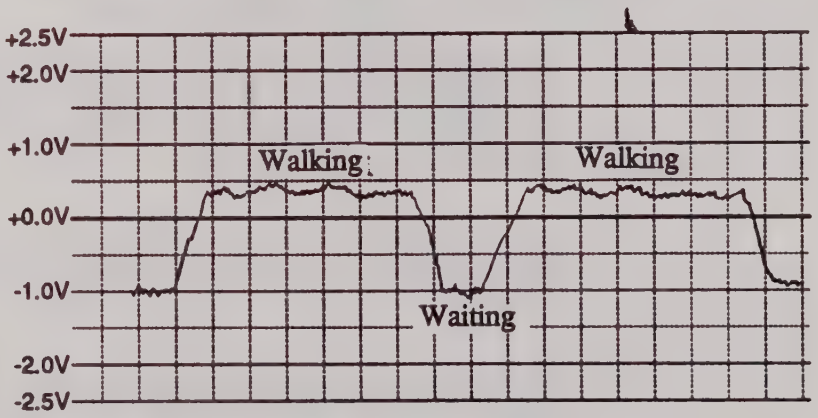
4. Start walking heel-to-toe at a point of 5 m (17 ft) before the beginning of the zone to be tested and continue down the center of the sensor cable route. When you reach the end of the zone, walk 5 m (17 ft) past the decouplers or terminators and stop. Wait for 20 seconds, turn around, and then walk slowly back down the center of the cable route in the opposite direction. Walk 5 m (17 ft) past the start of the zone, stop, and wait 20 seconds.

5. Observe the strip chart recording of your walk test. The recording should show voltage levels between +0.25 Vdc and +0.5 Vdc for the period of time you were walking down the center of the cables. If the voltage levels average less than +0.25 Vdc, slide the sensitivity control up. If the levels average more than +0.5 Vdc, slide the control down. If this is one of your first installations, you may have to experiment a little to find out how far to move the Sensitivity controls.



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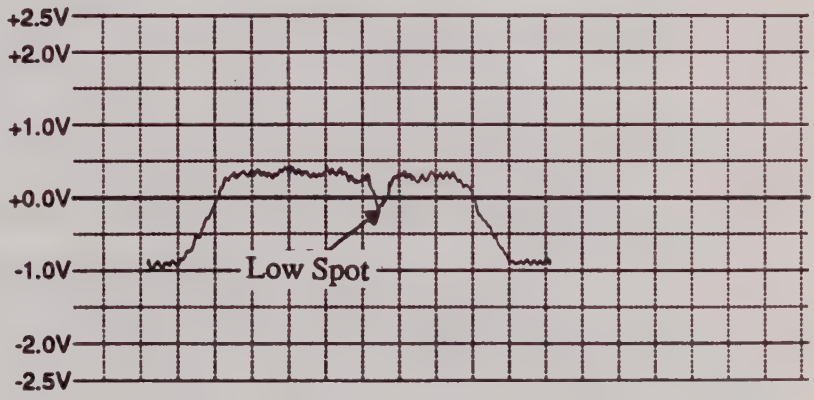
6. Once you've obtained voltage level that average between +0.25 Vdc and +0.5 Vdc for your walk test, look at your chart recording and make sure the voltage doesn't drop below +0.1 Vdc. If there are places where the voltage is below 0.1 Vdc, slide the Sensitivity control slightly higher. But make sure you don't push the sensitivity higher than +0.5 Vdc.

7. Very narrow spikes of low voltage can often be ignored. If there are points in the walk test where the voltage consistently drops well below +0.1 Vdc, mark the points where these low spots occur along the cable route and consult the Improving Sensitivity section in this chapter.



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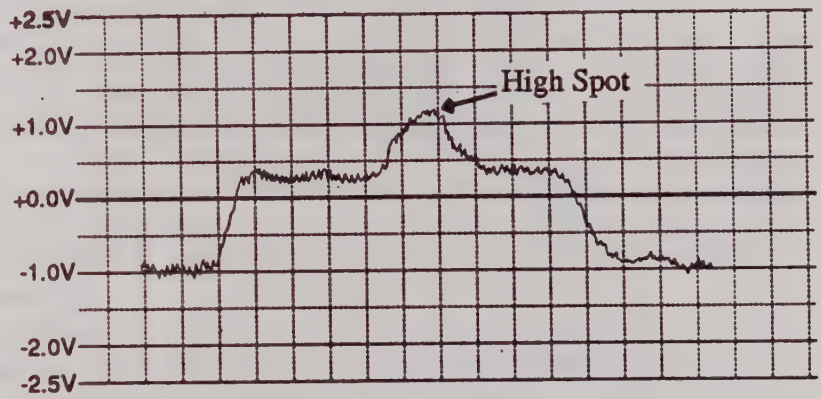
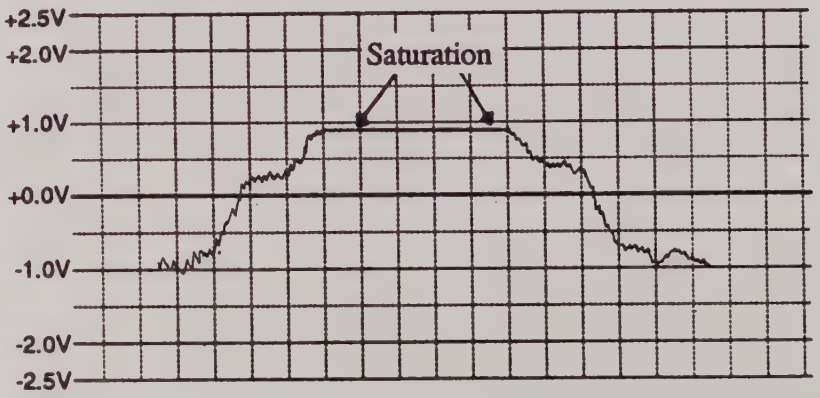
8. Look for spots on the chart recording where the sensitivity goes higher than +1.0 Vdc. The increased sensitivity in these areas of the zone may cause false alarms. Lower the sensitivity, if possible. If there's little vehicular or pedestrian traffic near this area of the zone, it's unlikely there will be a problem. If there's a lot of traffic in the area of high sensitivity, consult the Improving Sensitivity section for more information.



9. Look for smooth, flat, high sections on the chart recording. These indicate that the zone is saturated. Adjust Panther according to the Saturation procedure in the Improving Sensitivity section.



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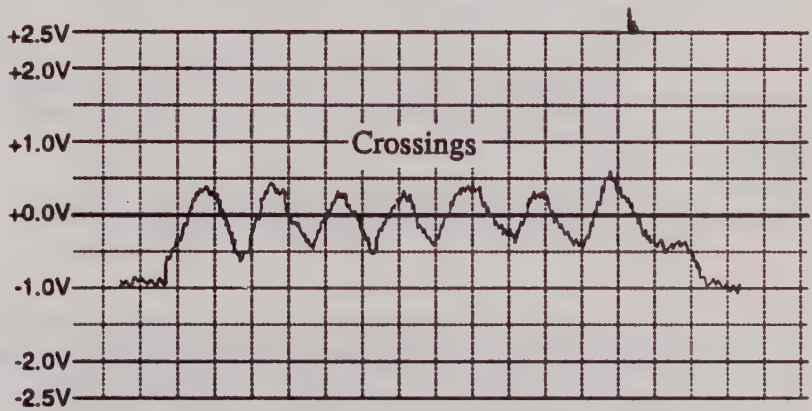
10. Press the Reset switch and then walk the length of the zone, but outside the detection field. The strip chart should indicate less than 0.0 Vdc.

11. Repeat the last step, but on the other side of the cable route.

12. Walk the length of the zone outside the detection area. At 1 m (3 ft, 3 in) intervals, cross to the opposite side of the cable route. The the strip chart should indicate approximately +0.25 Vdc to 0.5 Vdc for each crossing. Wait at least 20 seconds between crossings to allow Panther's electronics to reset following your previous intrusion.



13. Look for points in the zone where you achieve exactly +0.5 Vdc when you cross the cables. Try to pick locations that have an easily identifiable landmark nearby. Mark these locations on your site plan so you can use them as test crossing points during customer acceptance testing.

14. Repeat the test for the second zone, if there is one.

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Vehicle Protection

In vehicle protection applications, the vehicles are parked directly over the sensor cables. The vehicles actually become enveloped by the detection field, providing superior protection.

You must set the sensitivity level slightly lower for vehicle protection applications than you would for normal applications. The sensitivity must be reduced because the vehicles have a tendency to move slightly in the wind, which may produce false alarms. Remember that Panther is more sensitive to larger objects. The vehicles only have to move a small amount to produce an alarm. Your goal is to adjust the sensitivity so that small movements in the vehicles are ignored, but intruders are still detected.

Before you start setting the sensitivity for a vehicle protection application, you must first decide how you want to protect the vehicles. Panther's sensitivity can be set to detect intruders who attempt to:

- cross the sensor cables in between the vehicles
- touch the back or front of the vehicles

If you decide you want to detect intruders who cross the cables, the sensitivity level must produce a strip chart reading between +0.1 Vdc and +0.25 Vdc each time you cross the cables.

If you want to detect intruders who merely touch the front or back of the vehicles, you must set the sensitvity so that the strip chart records values between +0.1 Vdc and +0.25 Vdc each time you touch the back or front of the vehicles. Of course, you will have to set the sensitivity slightly higher for this degree of protection than you would if you wanted to detect intruders who cross the cables. Remember that as the sensitivity is moved higher, you may begin to experience false alarms caused by small movements in the vehicles.

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The initial procedure for setting sensitivity in vehicle protection applications is exactly the same as the procedure given on the previous pages. However, there are additional steps that must be followed. They are given below.

1. Set the sensitivity of each zone with no vehicles present. Use the procedure given in The Procedure section of this manual.

2. Park the vehicles directly over the cables.

3. Make sure no one is standing near the vehicles and press the Reset switch. Keep your chart recorder running.

4. If you want to detect intruders who cross the cables between the vehicles, walk along the cable route and cross back and forth across the cables between each vehicle as you go. Lower the sensitivity until you achieve a minimum of +0.1 Vdc and a maximum of +0.25 Vdc each time you cross the cables.

5. If you want to detect intruders who touch the back of the vehicles, walk along the cable route and touch the back of each vehicle. Repeat the test on the other side of the vehicles, if you wish. Adjust the sensitivity until you achieve a minimum of +0.1 Vdc and a maximum of 0.25 Vdc each time you touch a vehicle.

6. Walk along the zone about 2 m (6 ft, 6 in) away from each vehicle. The strip chart should show voltage levels less than 0.0 Vdc, indicating that no alarm is generated. If an alarm is generated, adjust the sensitivity.

7. Repeat all of these tests for the second zone, if there is one.

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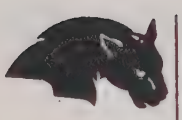


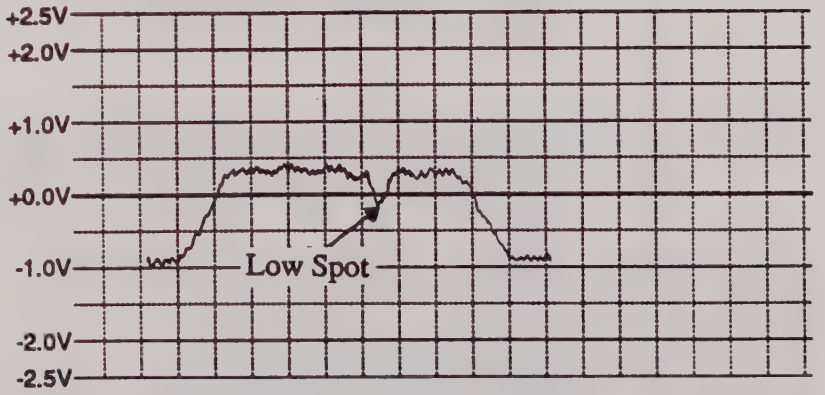
Improving Sensitivity

When you calibrate Panther, you will find that analog output voltage varies at different points along the zone. This section tells you:

- how to determine if there really are problems
- what you can do to correct them

Two people, each carrying two-way radios, can quickly locate high and low spots along the cable route. You can look for high and low spots by yourself, but a great deal of time-consuming trial and error is required. The procedures given in this section are provided with the assumption that you have an assistant and two-way radios.

Low Spots



Low spots in sensitivity may present problems if they are below 0.0 Vdc (0 units) when the rest of the zone is between +0.25 and +0.5 Vdc. An intruder may not be detected in areas of very low sensitivity. Raising the sensitivity of the whole zone so the low spot is at +0.1 Vdc may make the rest of the zone too sensitive and cause false alarms. To test areas of low sensitivity, follow the procedure on the next page.

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1. Have your assistant walk along the zone between the sensor cables while you observe the chart recorder. Tell your assistant to drop a marker (without stopping) when you notice the low spot being drawn on the chart recording. Have your assistant drop another marker where the low spot ends.

2. Keep the chart recorder running and walk across the cables several times at the point where the low spot occurs.

3. If each crossing generates an alarm (positive voltage levels greater than 0.0 Vdc), the zone needs no further adjustment.

4. If no alarm is generated in the low spot, you can do the following:

   - locate and remove any buried pipes or metal objects immediately beneath the cables
   - raise the cables a few inches closer to the surface at the point in the zone where the low spot occurs

Buried pipes and metal objects can reduce the sensitivity of the detection field if they're too close to the cables. They should be removed if they cause low spots. If you can't remove or locate these objects, you can compensate for the reduced sensitivity by bringing the sensor cables closer to ground level. The closer the sensor cables are to the surface, the more sensitive the detection field becomes.

If the low spot persists despite your efforts to correct it, you may choose to ignore the problem. Unless the low spot occurs in an area that is crucial to the security of the site (e.g., in front of a gate), it's unlikely that an intruder will attempt to cross at exactly that spot. If it is a crucial area, you may have to provide additional protection at that spot by using some other sensor.

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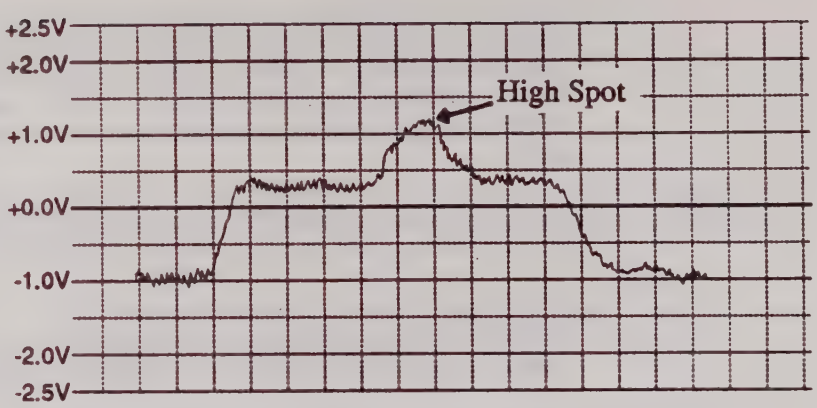
High Spots



A high spot is categorized as any voltage level above +1.0 Vdc. High spots don't always adversly affect the operation of the system. Human intruders are still detected in these areas, but smaller targets such as small animals and birds might also be detected. Also, larger targets such as moving vehicles or humans could be detected if they're in the immediate vincinity of the high spot. A high spot may cause false alarms if it's within 4 m (13 ft) of:

- areas of high pedestrian traffic
- a frequently-used road
- a loose metal fence

If there is an area of high pedestrian traffic near the high spot:

1. Keep your chart recorder running and walk along the pedestrian path near the high spot.

2. If no alarm is generated (a negative voltage level less than 0.0 Vdc), you may choose to ignore the problem. If an alarm is generated, bury the cables a few inches deeper at the high spot to reduce the sensitivity of the detection field.

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If there is a road near the high spot:

1. Drive a large vehicle, preferably a truck or bus, down the road near the high spot.

2. If no alarm is generated, you may choose to ignore the problem. If an alarm is generated (a positive voltage level higher than 0.0 Vdc), bury the cables a few inches deeper in the area near the high spot to reduce the sensitivity of the detection field.

If there is a loose metal fence near the high spot:

1. Shake the fence at a point near the high spot.

2. If no alarm is generated, you may choose to ignore the problem. If an alarm is generated (a positive voltage level higher than 0.0 Vdc), bury the cables a few inches deeper in the area near the high spot to reduce the sensitivity of the detection field.

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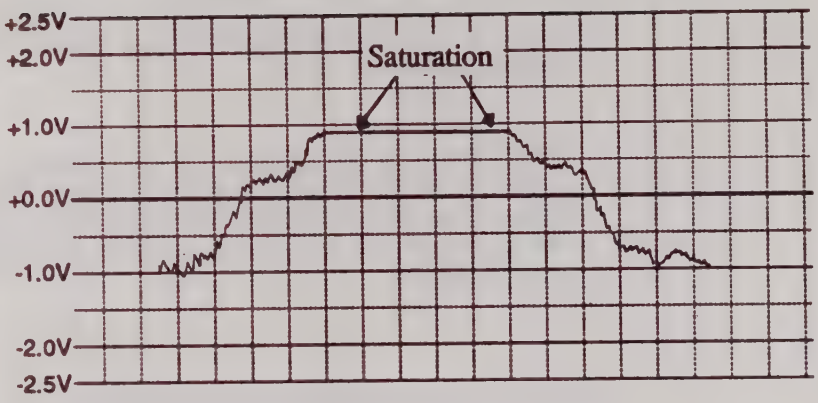
Saturation



If a chart recording of a zone produces a smooth, flat, high response during a walk test, the receiver electronics are being saturated. Saturation can occur in areas where the soil conditions make Panther too sensitive. Reduce Panther's sensitivity by following the procedure given below.

NOTE: This procedure reduces the sensitivity of **both** zones.

1. Disconnect the power. Disconnect the sensor cables, the ground connection, and the ribbon cable from the electronics module.

2. Place your hand underneath the Tx and Rx connectors and grasp the bottom of the electronics module.

3. Unsnap the bottom of the detection electronics module from the housing by pulling firmly.

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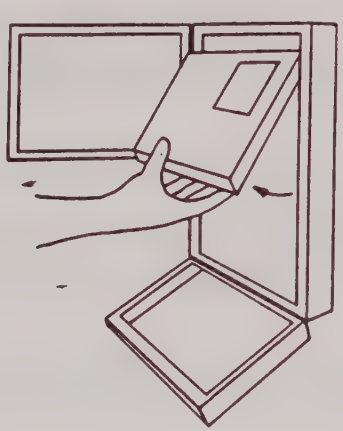
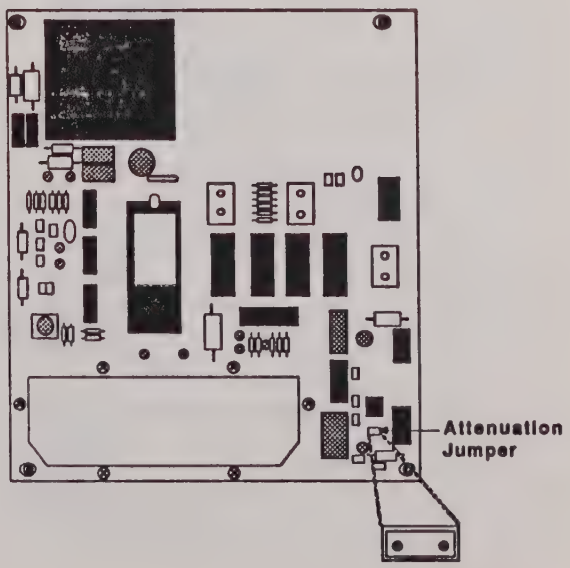
4. Swing the electronics module out and downward to remove it from the housing.



5. Locate the attenuation jumper on the back of the electronics module as shown in the illustration below.



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6. The jumper block is attached to one pin on the jumper. Pull the block off of the pin and push it back onto both pins.

7. Replace the detection electronics module in the housing and re-connect the sensor cables, the ground connection, the ribbon cable, and the power.

8. Re-calibrate **both** zones.

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Finishing Up

Before you demonstrate the system to the customer, you must follow the procedure given below.

Site Plan

1. Place a copy of the site plan in the inside front pocket of the Panther Owner's Guide. Make sure that the test crossing points for each zone are marked on the site plan.

Installation Label

2. Complete the information on the installtation label and attach it to the inside front cover of the Owner's Guide.

Information about your Panther system

Serial number: _____

Installation date: _____

Installer's name: _____

Calibration date: _____

Number of zones: _____

Sensitivity Control Settings

	Zone A	Zone B
Summer		
Winter (frozen ground)		

Detection Meter Readings

	Zone A	Zone B
Normal (green)		
Alarm (red)		

Your Dealer

Name: _____

Address: _____

Phone: _____

Emergency phone: _____

Your Central Alarm Monitoring Service

Name: _____

Address: _____

Phone: _____

Emergency phone: _____

Account number: _____

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3. Clip the Owner's Guide inside the detection unit top door.

Adjusting the Tamper Switch

4. Set option selection switch 6 to the open position to enable the door tamper alarm.

5. Close and lock the detection unit doors. The Warning light should be off. If the light remains on, adjust the Tamper switch plunger by using step 8 of this procedure.

6. Attempt to open the locked door. Do not use excessive force. It should stay shut and the tamper warning alarm should not trigger.

7. Unlock the door and begin to open it. The tamper warning alarm should trigger immediately.

8. If a warning alarm is generated too soon, the tamper switch plunger located on the door is too short. Lengthen the plunger by turning it counterclockwise with a screwdriver.

9. Reset and re-adjust the plunger until operation is satisfactory.

10. Perform the customer acceptance test described in the next section.

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Customer Acceptance Testing

Walking the Route

Walk the cable route with the customer and carry a copy of the site plan with you. Point out:

- poor fencing that should be repaired or removed to reduce the possibility of false alarms
- materials stored too close to the cable route which could cause false alarms
- any vulnerable areas
- how the cable route is marked on the site plan
- test crossing points marked on the site plan

Demonstrating the Unit

Demonstrate the following for the customer:

- how to unlock and open the top door of the detection unit
- all of the lights and controls on the detection unit
- how to process alarms
- the location of the Panther Owner's guide, installation label, and site plan (inside the top door)
- the sensitivity adjustment procedure in the Owner's Guide

Customer Crossing Test

It's possible for one person to do the crossing test by using the detection meter and Hold button located on the detection unit. This button makes the detection meter hold the maximum value registered during a test. Unfortunately, it does not give any indication of the range of readings encountered, so it must not be used for anything other than quick confirmations of proper operation.

The procedure given below is the same as the procedure given in the "How do I Test the System" section of the Owner's Guide. Have the customer follow through the procedure with you. Point out that this procedure may be necessary to compensate for sensitivity changes whenever the ground freezes or thaws.

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If you're testing a site designed for vehicle protection applications, perform this test with the vehicles parked on top of the cables. Explain to the customer that Panther indicates slightly lower detection meter readings during test crossings when vehicles are present. However, if you've set the sensitivity correctly you should always obtain a reading in the red whenever you cross the cables.

1. Using the instructions given in the "What Do the Controls Do?" section of the Panther Owner's Guide, open the top door to access the controls. The yellow Warning light should glow. An annunciator may sound unless you have permitted access to the system.

2. You must test each zone separately. Use the Zone switch to select the zone to be monitored by the detection meter.

3. Set the Hold switch to the "On" position.

4. Press the Reset button to clear the detection meter reading.

5. Walk across the sensor cables at the test crossing point in the zone you are testing (see your site plan). Walk at a normal pace.

6. The detection meter should indicate a reading from +5 to +10. If it does, skip the next step and go on to step 8. If you are testing a vehicle protection installation, any indication above 0 is acceptable.

7. If the reading is below +5 or above +10 (below 0 for vehicle protection installations), slide the sensitivity control for the zone you are testing until the detection meter indicates the desired reading. Return to step 4.

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8. If there is a second zone, use the Zone switch to set the detection meter to monitor that zone. Repeat steps 4 to 7.

When testing and adjustment is complete:

1. Set the Hold switch to the "Off" position.

2. Make sure there is no one in the detection field and observe the detection meter readings for each zone. The readings should be in the green (below -10 Vdc).

3. If the detection meter readings are in the yellow or red in either zone, the sensitivity is too high in the zone giving those readings. Re-adjust the sensitivity as described above.

Customer Sign-off

Have the customer sign the approval portion of the work order once the demonstration is complete and hand over both detection unit keys.

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Sample Installations

Case 1 -- D. Coder Cable Co.

Case 2 -- The Draconian Embassy

Case 1 -- D. Coder Cable Co.

The Problem

D. Coder Cable Co. has a fleet of vans that they use for their service operations. The vans contain expensive equipment and are parked overnight in the company parking lot. The company needs a security system that will detect intruders who attempt to tamper with the trucks. They want an alarm to be signalled at the alarm panel monitored by their night watchman.

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The Solution

Bob Jones chose to install a Panther system around the asphalt parking lot. The vans are parked on top of the cables every night. Bob proposed that Panther be connected to the alarm panel located at the front entrance to the building.

Key Points

Bob drew a site plan and outlined the following points about the installation:

- A single zone would be installed in an open loop configuration.
- The asphalt was thicker than 15 cm (6 in) so slots could be cut into the surface.
- The company wanted to do the installation quickly so Bob decided to cut the slots with a concrete saw.
- To keep costs down, Bob decided to seal the slots with sand and hot tar.
- A 2 m (6 ft, 6 in) spacing is used for the cables.
- The outside cable is placed 5 m (16 ft, 5 in) from the chain link fence to minimize false alarms due to the fencing.
- The terminators are buried beneath the lawn at the front of the building.
- The installation had to be done on a weekend when the company is closed to minimize disruption to their daily business.

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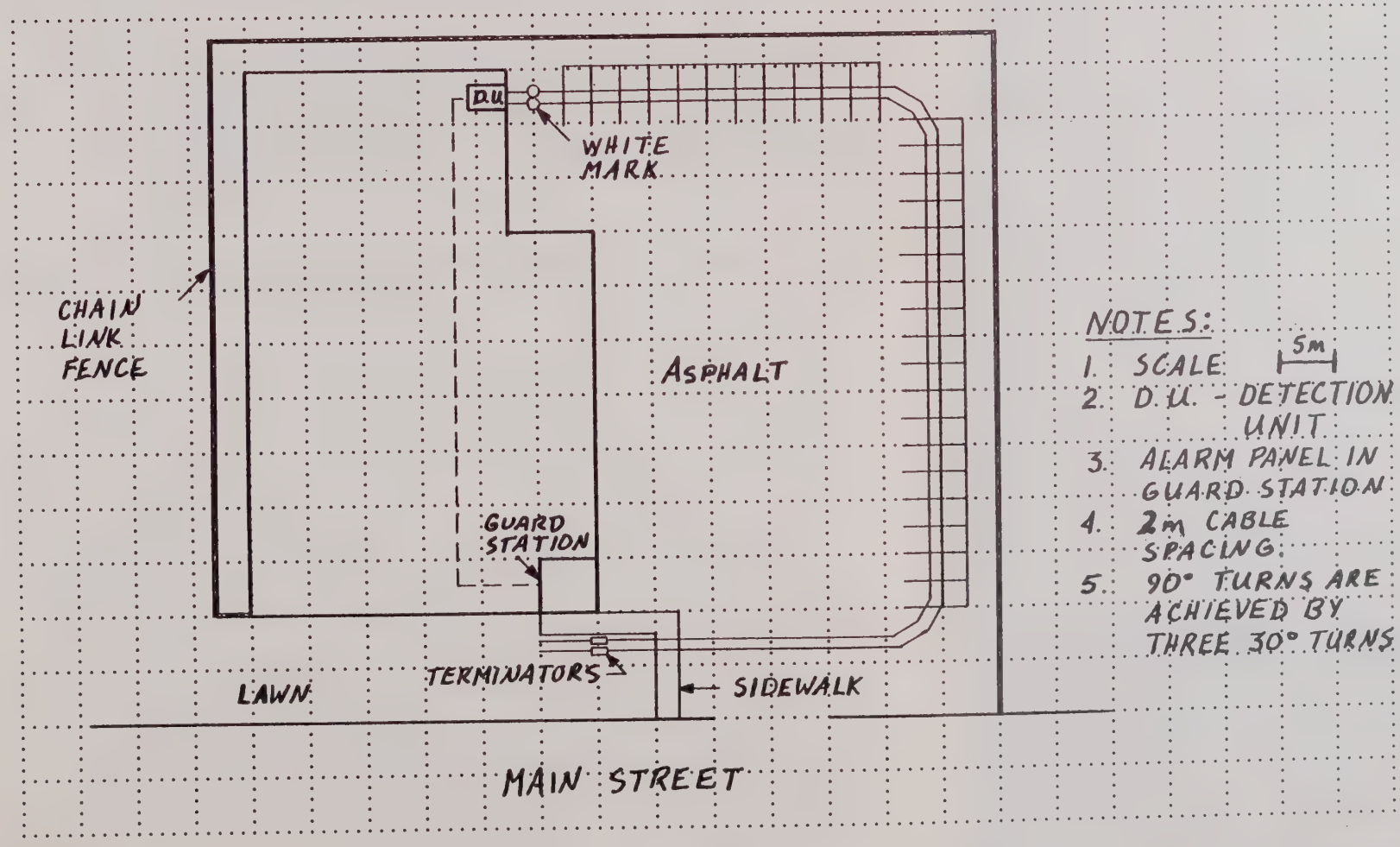
Site Plan

Panther™

Customer: D. CODER CABLE CO. **Prepared by:** BOB JONES **Date:** MAY 15, 1987



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Saturday, 9:00 a.m. :

Preparing the Site

Bob arrived at the site with Fred Smith, his assistant. Fred measured the length of lead-in required inside the building. He also located and cleared the area where the detection unit would be mounted. At the same time, Bob walked the cable route with the site plan and checked for obstacles. He checked the area at the back of the building where the lead-in cable was to enter the building. A hole would have to be drilled into the foundation of the building close to ground level.

After Bob walked the proposed cable route, he marked it using a tape measure and some spray paint. To place the outside cable, he measured 5 m (16 ft, 5 in) from the chain link fence and 6 m (19 ft, 6 in) from the street. He used the procedures given in the Installing the Cables section of this handbook to turn the 90° corners.

Bob got out his Installer's Checklist and checked off each relevant item as he went.

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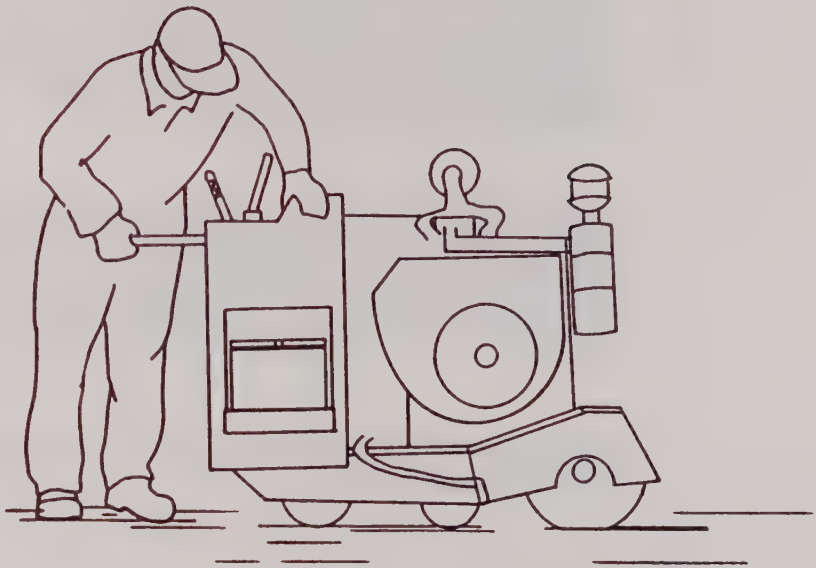
9:50 a.m. : **Cutting the Asphalt**



Slots were cut into the asphalt using a concrete saw. The slots for both cables were cut according to the specifications given in the Installing the Cables section of this handbook.

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11:00 a.m. : The area around the slots was swept clean.

11:30 a.m. : Bob used a push-pipe to tunnel under the sidewalk while Fred used a shovel to dig trenches in the soil for the terminators.

12:30 p.m. : **Lunch**

1:00 p.m. : **Checking the Cables**

The cables were tested for continuity according to the procedures given in the Installing the Cables section of this manual. The lead-in cable was identified by stripping a cable end and looking for metal foil.

1:15 p.m. : **Laying the Cables**

The cables were dispensed from the cable caddies and laid into the slots. Care was taken to avoid damaging the cables as they were placed in the slots. Bob double-checked that the white ring on each cable was located in the spot indicated on the site plan. They immediately labelled the lead-in cables with one of the label sets. They labelled the outer cable "TXA" and inner cable "RXA".

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2:35 p.m. : **Laying Sand**

A thin layer of sand was laid on top of the cables. The sand prevents the hot tar from melting the cable jacket. Bob and Fred poured the sand directly from opened sand bags. After the sand was poured, they swept the area clean.

3:15 p.m. : **Installing the Terminators**

Bob and Fred installed a terminator on each cable. They used the instructions given in the Making Connections and Splices section of this handbook. They cut the cables to a length that allowed them to leave a little slack cable in the trenches. The trenches were filled and the sod replaced.

3:45 p.m. : **Pouring the Tar**

The slots were filled with hot tar to the surface. Before the tar was poured, Bob dipped a small piece of cable into the tar to make sure that the tar wasn't too hot. If the cable jacket had melted, the tar would have been too hot. It wasn't and they began pouring. They followed the instructions given in the Installing the Cables section throughout this procedure.

Just as they reached the lead-in section of the cable, Bob realized that they had forgotten to put on the ferrite beads. They pulled the lead-in cables out of the slots and installed the ferrite beads, fastening them in place with the plastic retainers. They then had to clean the sand out of the bottom of the slots so that they could relay the cables and recover them with sand. They both agreed they would never forget to install ferrite beads again.

5:30 p.m. : **End of the Day**

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Sunday, 9:00 a.m. :

Drilling the Cable Entrance and Mounting the Detection Unit

Bob used a mortar drill to create a hole large enough to feed the lead-in cables into the building. While the drilling was going on, Fred mounted the detection unit on the wall. He used the instructions given in the Installing the Detection Unit section of this handbook.

Feeding the cables into the building presented no problems since the detection unit was to be mounted on the wall directly over the drilled hole. Conduit was used outside to cover the lead-in cables for the short distance from the asphalt to the hole. Conduit was also used to run the cables from the floor of the building into the bottom of the detection unit. A 2 m (6 ft, 6 in) service loop was left under the floor.

9:45 a.m. :

Installing the Connectors

Before Bob and Fred cut the cables to the proper length, they re-labelled them. They then installed the connectors on the lead-in cables at the detection unit. They used the procedures given in the Making Connections and Splices section of this handbook. Once the connectors were installed they measured each cable to test for the 130 kΩ terminator resistance. They didn't attach the connectors to the transmit and receive ports until after the next step.

10:30 a.m. :

Connection to the Alarm Panel and Power Supply

Bob unpacked the terminal connection module from the detection unit carton and began to connect the wires that were to go to the alarm panel and power supply. The alarm panel required supervision resistors and so these were installed in the correct sockets on the terminal connection module. He used the instructions given in the Installing the Detection Unit section of this handbook.

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Fred ran the wires through the false ceiling to the alarm panel and power supply at the front of the building. Conduit was used to cover the wires where they ran along the walls from the detection unit and the alarm panel.

Bob and Fred made all final connections but made sure that no power was applied to the Panther detection unit. There was only one zone at this site, so they connected the transmit and receive sensor cables to the TXA and RXA connectors at the detection unit. They attached a load set to the unused TXB and RXB connectors to provide rf termination and prevent those connectors from picking up stray signals.

11:40 a.m. : **Lunch**

12:30 p.m. : **Initial Testing**

All the connections were tested by carrying out the functional test given in the Commissioning section of this handbook. The detection unit functioned normally.

12:40 p.m. : **Setting up the Chart Recorder**

Bob and Fred used the procedures given in the Commissioning section of this handbook to connect and calibrate their chart recorder. They used a dual-channel recorder even though there was only one detection zone at this particular site. All of the strip charts produced during the set up procedure appeared as they were supposed to, so they began to prepare for the sensitivity setting procedure.

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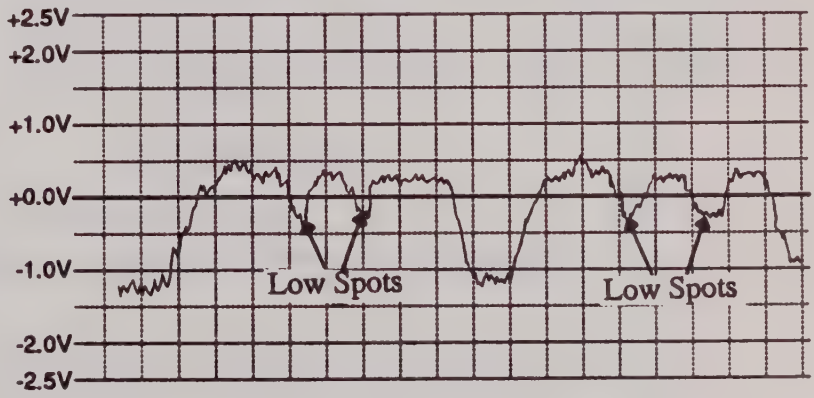
1:00 p.m. :

Setting Sensitivity

The sensitivity was initially set by using the Sensitivity A control and the detection meter values indicated in the Commissioning section of this handbook.

Fred had never done a walk test before, so he volunteered to walk down the center of the cables. He communicated with Bob inside the building with a two-way radio. He started walking between the cables at the location of the buried white rings (white marks) and continued until he'd walked 5 meters past the terminators. Then he waited until Bob signalled him to start walking back down the cables in the opposite direction.

Fred's walk test produced the following chart recording:



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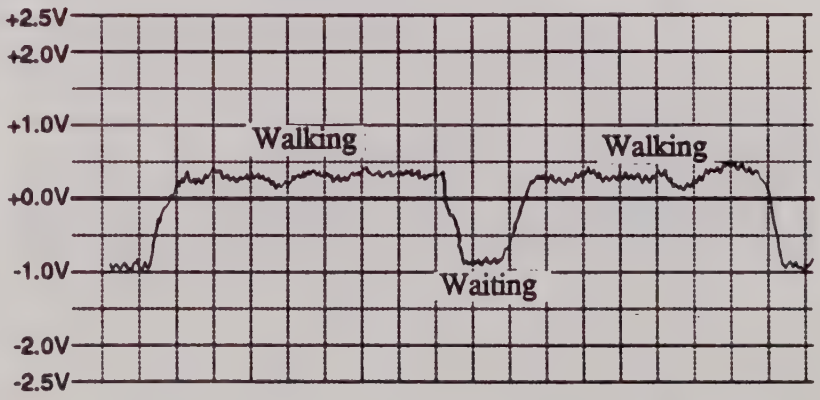
They noticed an unusually large number of sensitivity dips in the chart recording of Fred's walk test. They also noticed that it didn't take Fred long enough to walk the length of the zone. They concluded that he hadn't walked heel-to-toe and that the dips in sensitivity were false ones created by his fast pace. Bob showed Fred how to walk heel-to-toe and the walk test was repeated.

The new walk test produced the following chart recording:



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The walk test was judged satisfactory so they parked all of the vans on top of the cables. The sensitivity was re-adjusted according to the Vehicle Protection procedure in the Commissioning section of this handbook. After the sensitivity was re-adjusted, Bob was able to generate an alarm by walking between each van and by touching the back of each van.

2:15 p.m. : **Customer Acceptance**

The system was demonstrated to the owner and the security guard who was on duty at the time. Bob did a crossing test and demonstrated the detection unit as indicated in the Customer Acceptance procedure in the Commissioning section of this handbook. The owner and guard followed the sensitivity adjustment instructions given in the Panther Owner's Guide as the crossing test was performed. The guard was shown how Panther's alarms were to be processed on the alarm panel. The owner signed the acceptance and then was given both keys to the detection unit's top door.

2:40 p.m. : **Installation Complete**

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Case 2 -- The Draconian Embassy

The Problem

The Draconian embassy is in need of increased security due to international tension centering around the country of Draconia. Embassy officials wish to avoid installing unsightly security fencing or increasing the number of armed guards stationed at their embassy (presently two guards). They want to avoid the appearance of increased security. The embassy is located in a rather exclusive neighboorhood and there are local regulations requiring property owners to maintain an aesthetically pleasing environment.

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The Solution

Bob Jones chose to install a Panther system around the perimeter of the embassy grounds. The Panther detection unit would be connected to an alarm panel located at the guard station inside the embassy near the front door. Panther would complement an already elaborate security system that includes interior passive infra-red sensors, microwave sensors and CCTV cameras.

Key Points

Bob drew a site plan and outlined the following points about the installation:

- Bob couldn't place the cables along the fence because the total fence perimeter is slightly larger than 300 m (984 ft).
- He had to route the cables around a septic system.
- A 300 m (984 ft) two-zone decoupled system was required to completely surround the embassy.
- Bob placed the decouplers at the gravel/soil transition.
- One zone crosses three types of mediums: soil, asphalt, and gravel. Bob realized that this was unavoidable, and so he decided to keep the sensitivity of the zone uniform by installing the cables beneath the asphalt.
- The installation had to be done quickly and could not leave any scars, so Bob decided to use a sod remover and a small trenching machine to install the cables.

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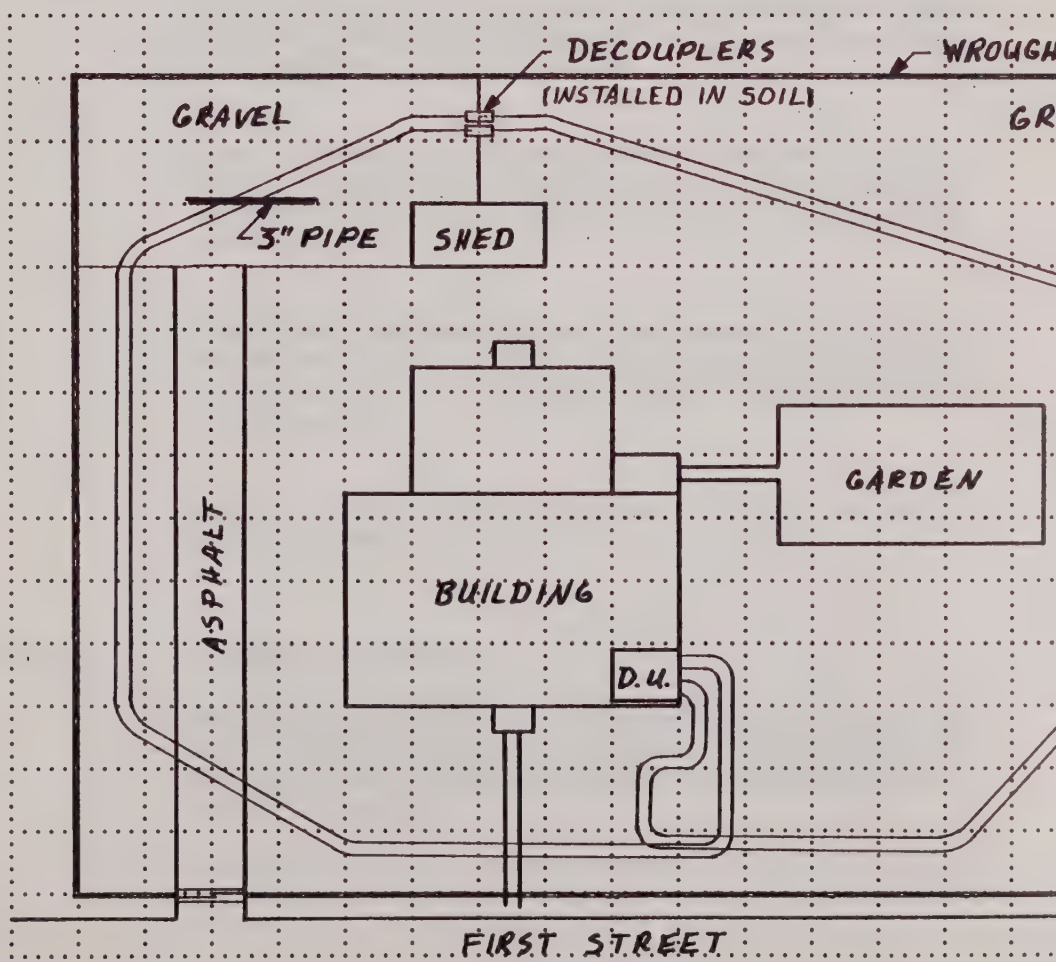
Site Plan

Panther™

Customer: DRACONIAN EMBASSY **Prepared by:** BOB JONES



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Monday, 8:00 a.m. :

Preparing the Site

When Bob and Fred arrived at the site they unloaded and prepared the small trenching machine. Bob walked the cable route with the site plan and checked for obstacles. He checked the area at the side of the embassy where the lead-in cable was to enter. A hole would have to be drilled into the foundation of the building slightly above ground level.

At the same time, Fred measured the length of lead-in required inside the building. He also located and cleared the area where the detection unit would be mounted.

After Bob walked the proposed cable route, he marked the route using a tape measure and some spray paint. Bob used the trees and the driveway as references for placing the cables in the correct spots.

Bob refered to the Installing the Cables section of this handbook for the overlap dimensions. He made sure that the marked locations of the white rings (white marks) on the cables were 8 m (26 ft) apart.

Bob got out his installer's checklist and checked off the relevant items as he went.

9:10 a.m. :

Checking the Cables

The cables were tested for continuity according to the procedures given in the Installing the Cables section of this manual. The lead-in cable was identified by stripping the end of the cable and looking for metal foil.

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9:30 a.m. :

Installing the Overlap

The overlap was installed before the rest of the cable route.

Bob and Fred removed and rolled up the sod along the cable route at the zone overlap.

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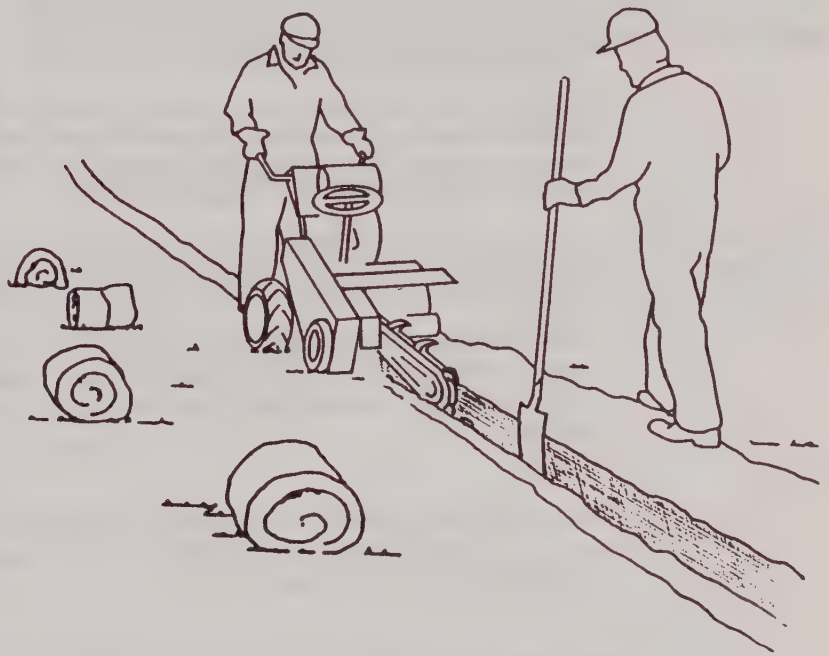
Then they dug the trenches for the overlap only. While digging, they used a marked shovel to make sure the trench stayed at the proper depth.



They slid ten ferrite beads onto the lead-in section of each cable, fastening them at the correct distance from the white mark with the retainers.

They placed the cable in the trenches and made sure the white rings were lined up according to the specifications on the site plan and those found in the Installing the Cables section of this handbook. They labelled each of the cables, ensuring that the outer cables were labelled transmit and the inner ones receive.

The remaining cable for both zones was left coiled in the cable caddies. The lead-in cable that was to be run into the building was coiled and left near the proposed entrance area.

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12:30 p.m. : **Lunch**

1:00 p.m. : **Digging One Trench for Zone B**

The cables were installed one at a time. In other words, sod was removed, one trench was dug, a cable buried in the trench and the sod replaced. Then the whole process was repeated for the other cable. They used this method because:

- The trenches didn't have to be left open for long periods of time, therefore reducing the possibility of damage to the cables.
- Wet weather was a possibility, but they knew that they would have time to install at least one cable before it rained.
- The trenching machine has a tendency to get caught in open trenches.

They also installed one whole zone before starting on the other zone. A small length of trench was left open where the decouplers were to be placed.

First, they installed the zone that goes around the garden to the back of the lot (Zone B). They followed the procedures for installing in soil given in the Installing the Cables section of this handbook. While Bob removed the sod with a sod cutter, Fred rolled up the sod behind him.

1:30 p.m. : **Laying Cable**

While Fred was digging the trench, Bob began unrolling the cable and placing it in the trench. He checked the depth every 30 cm (12 in) and packed dirt around the cable every few meters to keep the cable in the trench. He also inspected the cable for damage as he went.

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1:45 p.m. : **Restoring the Ground**

When the trenching and cable laying was complete, they began backfilling the trench and replacing the sod. Bob manned the shovel while Fred replaced the sod behind him. Excess dirt on the ground was dissipated with a grass rake.

2:40 p.m. : **Installing the Other Cable in Zone B**

They installed the remaining cable in zone B using the same procedure they used for the first cable. When the crew was done, only an expert observer could tell where cables had been buried in the lawn.

5:00 p.m. : **End of the Day**

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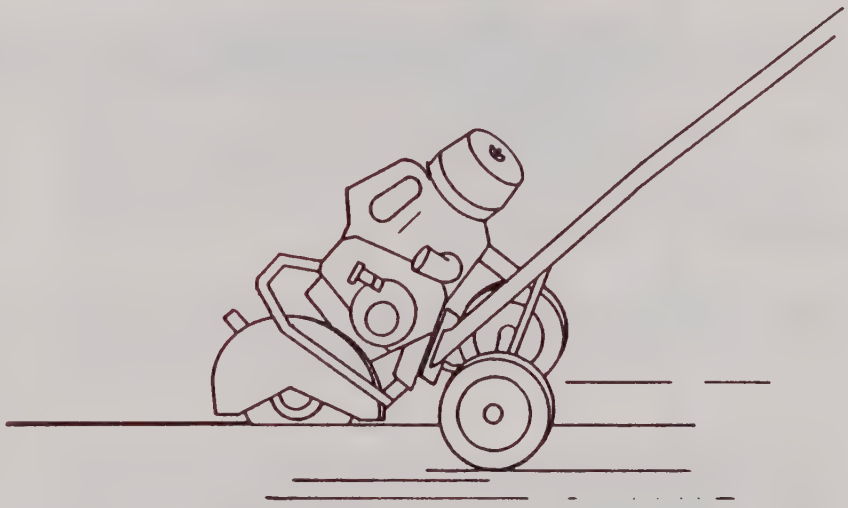
Tuesday, 8:00 a.m. :

Cutting the Asphalt and Digging in Gravel

Bob and Fred began the day by installing the first cable for zone A. They each took different duties. Bob began digging trenches in the gravel with the trenching machine (starting at the decoupler location), while Fred used a small asphalt cutter to remove a section of asphalt from the driveway.



A section of asphalt about 1.5 m (4 ft, 7 in) wide was removed. This width accomodates the 1 m (3 ft, 3 in) cable spacing and still leaves room for the width of the trenches. Sections of asphalt were pulled out with a pick axe.

While digging in the gravel, Bob discovered a 6 cm (3 in) pipe buried just below the level were the cables were to be buried. Using a shovel, a metal detector, and a utility map, he discovered that it was an empty metal pipe about 10 m (32 ft, 9 in) long. Rather than dig it up, he marked its location on the site plan and continued trenching.

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9:15 a.m. : **Digging the Trenches in Soil**

Bob finished trenching in the gravel before the asphalt could be removed, so he continued by removing the sod from the lawn along the driveway. He then trenched along the cable route until he reached the asphalt driveway.

10:30 a.m. : **Digging Trenches Under the Asphalt**

Bob began trenching where the asphalt had been removed. He dug slightly deeper than he did in the soil because he wanted to lay the cables on a thin bed of sand. He followed the instructions for burying cable beneath concrete/asphalt that are given in the Installing the Cables section of this handbook.

Fred began laying the cable in the trench. He used the same technique that he and Bob used to install the other zone.

11:30 a.m. : **Lunch**

12:15 p.m. : **Backfilling the Trenches**

The trenches were backfilled and the sod replaced. The gravel was raked so that the marks left by the trenching would be less conspicuous. The trenches under the asphalt were filled with sand to the level where the asphalt started. Bob and Fred followed the guidelines given in the Installing the Cables section of this handbook.

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1:10 p.m. : **Installing the Other Cable in Zone A**

Bob and Fred used the same procedure that they used to install the first cable in zone A, except they didn't have to remove any asphalt because it had been removed before the first cable was installed.

3:00 p.m. : **Restoring the Asphalt**

After backfilling the second cable in zone A, Bob called a paving sub-contractor to arrange for restoration the next day.

4:00 p.m. : **Installing the Decouplers**

Bob and Fred each installed one decoupler. They used the procedures given in the Making Connections and Splices section of this handbook. After they installed the decouplers, they tested for the 130 kΩ resistance and then buried them.

5:00 p.m. : **End of the Day**

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Wednesday 8:00 a.m. :

Drilling the Cable Entrance and Mounting the Detection Unit.

Bob used a mortar drill to create a hole large enough to feed the lead-in cables into the building. While the drilling was going on, Fred mounted the detection unit enclosure on the wall. He used the instructions given in the Installing the Detection Unit section of this handbook.

Feeding the cables into the building presented no problems since the detection unit was to be mounted on a wall in the basement directly under the drilled hole. Conduit was used outside to cover the lead-in cables for the short distance from the ground to the hole. A 2 m (6 ft, 6 in) service loop was left in the false ceiling in the basement.

8:30 a.m. :

Asphalt Restoration

The sub-contractor arrived and patched the asphalt. Since the patch was small, it did not take very long to do.

8:45 a.m. :

Installing the Connectors

Before they cut the cables to the proper length, they re-labelled the transmit and recieve cables (trimming to length would remove the labels already on the cables). They installed connectors on the lead-in cables at the detection unit. They used the procedures given in the Making Connections and Splices section of this handbook. They didn't attach the connectors to the transmit and recieve ports until later, but they did test for the 130 kΩ decoupler resistance on the cables.

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9:30 a.m. : **Connecting to the Alarm Panel and Power Supply**

Fred unpacked the terminal connection module from the detection unit carton and began to connect the wires that were to go to the alarm panel and the power supply. The alarm panel required supervision resistors so Fred installed them in the correct sockets on the terminal connection module. He used the instructions given in the Installing the Detection Unit section of this handbook.

Bob ran the wires along the basement ceiling and up through the floor to the alarm panel and power supply at the front entrance of the building. Conduit was used to cover the wires where they ran from the floor to the alarm panel.

Bob then connected the ground wire to the detection unit and ran it outside. He drove a ground rod into the soil and securely attached the ground wire, cutting off the excess. They made all final connections but made sure that no power was applied to the Panther detection unit.

10:30 a.m. : **Initial Testing**

All the connections were tested by carrying out the functional test given in the Commissioning section of this handbook. The detection unit functioned normally.

10:40 a.m. : **Setting up the Chart Recorder**

They used the procedures given in the Commissioning section of this handbook to connect and calibrate their chart recorder. They used a dual-channel recorder so that they could observe both zones at the same time. All of the strip charts produced during the set up procedure were normal, so they began to prepare for the sensitivity setting procedure.

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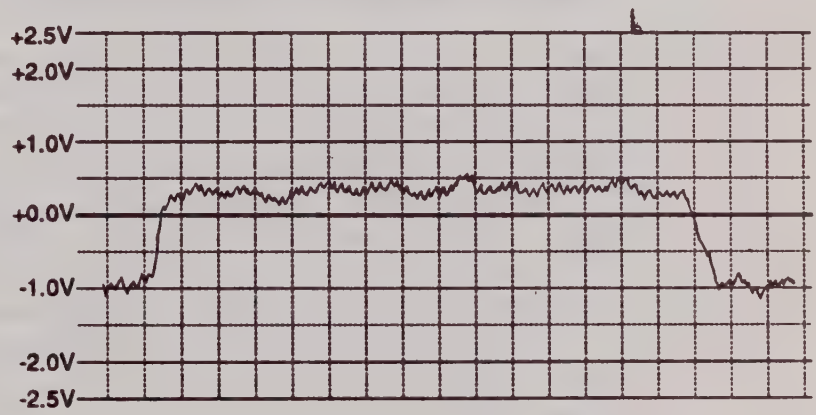
11:00 a.m. :

Setting Sensitivity for Zone B

The sensitivity was initially set by using the Sensitivity B control and the detection meter values indicated in the Commissioning section of this handbook.

Bob performed a walk test by walking heel-to-toe down the center of the cables while Fred watched the chart recorder inside. The two communicated with a two-way radio. After going past the decouplers, Bob waited for twenty seconds before walking back down the cables in the opposite direction.

The walk test produced a perfect chart recording and so no further adjustment was required.



11:45 a.m. :

Lunch

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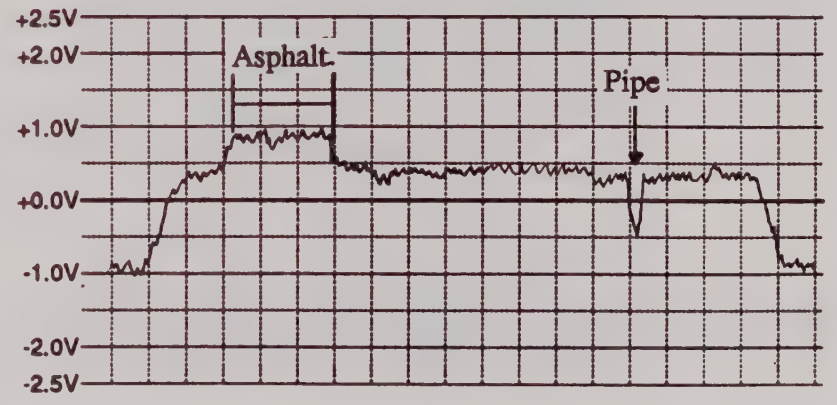
12:00 p.m. :

Setting Sensitivity for Zone A

The sensitivity was initially set by using the Sensitivity A control and the detection meter values indicated in the Commissioning section of this handbook.

Bob performed the walk test while Fred watched the chart recorder. They used the procedure given in the Commissioning section of this handbook.

When the walk test was complete, the strip chart showed a dip in sensitivity in the gravel parking lot. The dip appeared on both passes. It was obvious that the dip was being caused by the buried pipe that had been found while trenching in the gravel.



The walk test also showed slightly higher sensitivity along the asphalt driveway and the gravel parking lot. However, sensitivity variations are normal when passing from one medium to another. These particular variations did not present a problem.

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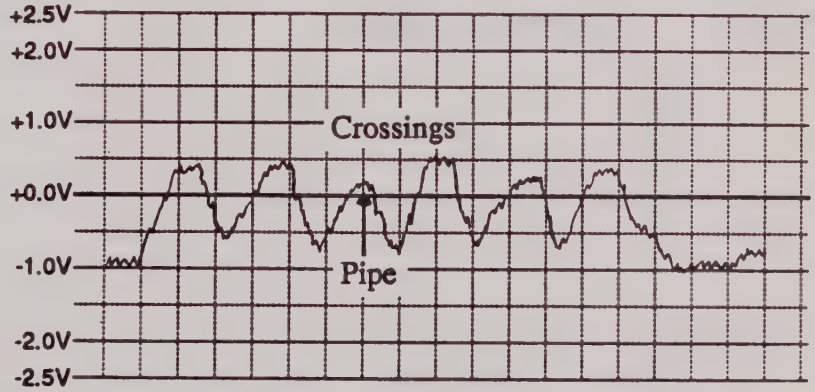
12:45 p.m. :

Doing a Crossing Test

Bob performed a crossing test at the location of the buried pipe. Each time he crossed the cables, the strip chart showed readings higher than 0.0 Vdc, which meant that he was detected in spite of the reduced sensitivity in that area. They decided it was not necessary to remove the pipe.

If they had encounted problems with the dip, they could have raised the cables a few inches closer to the surface in the area near the pipe. Throughout this test they referred to the procedures for improving sensitivity given in the Commissioning section of this handbook.



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1:10 p.m. : **Customer Acceptance**

The system was demonstrated for the embassy's head of security and his staff. Bob did a crossing test and demonstrated the detection unit as indicated in the Customer Acceptance procedure in the Commissioning section of this handbook. The security personnel followed the sensitivity adjustment instructions given in the Panther Owner's Guide as the crossing test was performed. They were shown how Panther's alarms were to be processed on the alarm panel. The head of security signed the customer acceptance and was then given both keys to the detection unit's top door.

2:00 p.m. : **Installation Complete**

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Installer's Checklist

Installer's Checklist

1. **Check the system design:** (Pg. 3-1 to 3-8)
- ☐ check the site plan measurements (Pg. 3-8)
- ☐ use newest equipment and techniques (Pg. 3-8)
- ☐ look for design errors (Pg. 3-8)

2. **Check your tools and part supply:** (Pg. 3-9 to 3-11)
- ☐ standard parts (Pg. 3-9)
- ☐ sufficient spare parts (Pg. 3-10)
- ☐ repair and accessory items (Pg. 3-10)
- ☐ standard tools (Pg. 3-10)
- ☐ cable burial tools (Pg. 3-11)
- ☐ damp weather tools (Pg. 3-11)

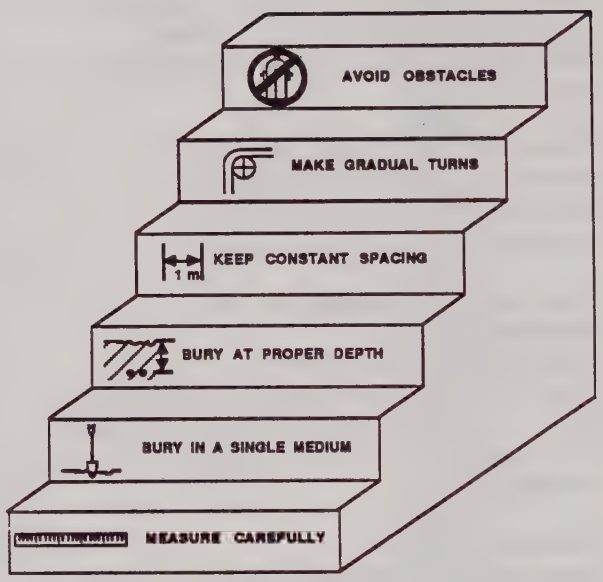
3. **Review connector procedures:** (Pg. 4-1 to 4-34)
- ☐ installing connectors (Pg.4-1 to 4-8)
- ☐ installing terminators (Pg. 4-14 to 4-16)
- ☐ installing decouplers (Pg. 4-16 to 4-19)
- ☐ making splices and repairs (Pg. 4-20 to 4-34)
- ☐ waterproofing connections (see terminators/decouplers)

4. **Prepare the site:** (Pg. 5-1)
- ☐ ensure the site matches the site plan (Pg. 5-1)
- ☐ clear debris from the sensor cable paths (Pg. 5-1)
- ☐ clear the area near the detection unit location (Pg. 5-1)

5. **Check for obstacles:** (Pg. 5-15 to 5-16)
- ☐ metal fences (Pg. 5-15)
- ☐ buildings (Pg. 5-15)
- ☐ standing water (Pg. 5-16)
- ☐ metallic debris (Pg. 5-16)
- ☐ buried walls (Pg. 5-16)
- ☐ underground wiring (Pg. 5-16)
- ☐ buried utility pipes (Pg. 5-16)

6. **Route the sensor cables:**
- ☐ refer to the handbook for corner dimensions (Pg. 5-6 to 5-14)
- ☐ mark the sensor cable paths with stakes, paint, or string
- ☐ mark the location of the "white rings" (Pg. 5-4 to 5-5)
- ☐ mark the sensor cable entrance to the building
- ☐ bypass problem areas (Pg. 5-17 to 5-19)

7. **Prepare the cables prior to burial:** (Pg. 5-20 to 5-23)
- ☐ test the cables for continuity and short circuits (Pg. 5-20)



The Golden Rule - Make Good Connections

- ☐ lay the cables along the proposed route with the non-detecting section near the detection unit (Pg. 5-21)
- ☐ check for jacket damage, repair if necessary
- ☐ label the lead-in ends of all the cables (Pg. 5-20 to 5-22)
- ☐ fasten 10 ferrite beads onto the non-detecting section of each sensor cable, properly spaced (Pg. 5-22 to 5-23)
- ☐ lay out the zone overlap area if required (Pg. 5-38)

8. **Cut a channel for the cable:** (Pg. 5-24)
- ☐ saw slots into concrete or thick asphalt (Pg. 5-31 to 5-35)
- ☐ cut and remove thin asphalt (Pg. 5-36 to 5-37)
- ☐ slit grass with a spade or sod slitter (Pg. 5-27 to 5-28)
- ☐ dig trenches in soil or below thin asphalt (Pg. 5-36 to 5-37)
- ☐ lay cable
- ☐ use sand to protect cable from gravel (Pg. 5-29 to 5-30)

9. **Attach the terminators/decouplers:** (Pg. 4-14 to 4-19)
- ☐ trim the detecting section of the cables to length (leave some slack)
- ☐ attach terminators or decouplers, as required
- ☐ allow for cable strain relief

10. Run the interior lead in: (Pg. 5-39 to 5-40)

- ☐ drill a hole in the wall of sufficient size for cables, attach conduit if desired
- ☐ feed lead-in cable from exterior to interior
- ☐ when you bury the exposed lead-in cable, leave a loop to allow for frost heaving, if necessary
- ☐ run lead in from entrance hole to detection unit, use conduit if desired

11. Mount the detection unit: (Pg. 6-1 to 6-2)

- ☐ unpack all detection unit parts (Pg. 6-1)
- ☐ install bushings on the housing (Pg. 6-2)
- ☐ mount the housing on the wall (Pg. 6-2)

12. Install adequate grounding for all components: (Pg. 6-3)

- ☐ attach ground wire to the housing
- ☐ DO NOT attach ground wire to the ac or dc grounds
- ☐ run ground wire to buried ground rod (earth ground)
- ☐ DO NOT run ground wire through sensor cable entrance hole

13. Install the modules:

- ☐ install the detection electronics module (Pg. 2-14)
- ☐ attach ground wire from the electronics module to the housing
- ☐ install supervision resistors on the terminal connection module if required (Pg. 6-10 to 6-14)
- ☐ coil a lead-in cable service loop (if desired) in an inconspicuous location
- ☐ attach connectors to the lead in cable (Pg. 4-1 to 4-8)
- ☐ label the cables
- ☐ make the alarm relay connections to the terminal connection module (Pg. 6-4 to 6-9)
- ☐ install the terminal connection module (Pg. 6-18)
- ☐ connect the sensor cables to the detection unit (Pg. 6-18)
- ☐ DO NOT apply dc power yet
- ☐ Set the option switch (Pg. 6-15 to 6-17)

14. Commission the system: (Pg. 7-1 to 7-26)

- ☐ check previous work before connecting dc power
- ☐ apply dc power
- ☐ do initial test of detection unit (Pg. 7-5 to 7-6)
- ☐ set up chart recorder (Pg. 7-7 to 7-10)
- ☐ set sensitivity for each zone using walk test (Pg. 7-11 to 7-19
- ☐ mark test crossing points on site plan

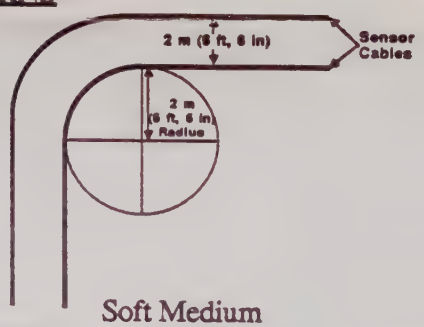
15. Clean up, do final check: (Pg. 7-27 to 7-31)

- ☐ remove debris from exterior and interior areas
- ☐ seal the entrance hole, patch any other openings
- ☐ double check all connections
- ☐ adjust the tamper switch pluger (Pg. 7-28)
- ☐ set the option selection switch as desired (Pg. 6-15 to 6-17)

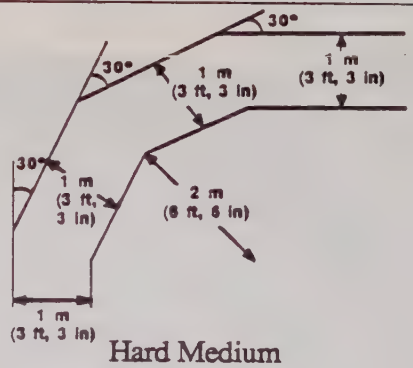
16. Obtain customer sign-off: (Pg. 7-28 to 7-31)

- ☐ walk the cable route with the customer (Pg. 7-29)
- ☐ explain and demonstrate system (Pg. 7-29)
- ☐ demonstrate the use of the detection meter (Pg. 7-29 to 7-31)
- ☐ have work order acceptance signed (Pg. 7-31)

GRADUAL TURNS

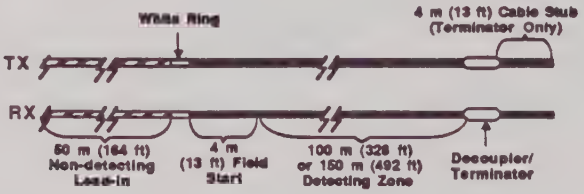


Soft Medium

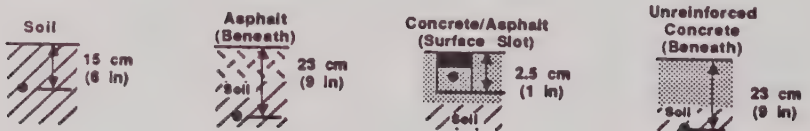


Hard Medium

CABLE LENGTHS


Wide Ring
4 m (13 ft) Cable Stub (Terminator Only)
TX
RX
60 m (164 ft) Non-detecting Lead-in
4 m (13 ft) Field Start
100 m (328 ft) or 150 m (492 ft) Detecting Zone
Decoupler/ Terminator

BURIAL DEPTHS



Glossary of Terms

Glossary

Adaptive Detection Methodolgy - automatic compensation for environmental changes. Panther is a "smart" alarm system that can adapt itself to changing background conditions. Manual re-adjustment is not required since Panther adjusts automatically.

Alarm Condition - a threatening condition, such as an intrusion.

Alarm Panel - equipment which activates a visible or audible alarm device and provides system controls. The Panther detection unit does not have a built in horn, buzzer or other alarm "annunciator". It has all of the necessary signal and control lines to allow connection to an alarm panel.

Attenuation - a reduction in the Panther sensitivity. Under some rare circumstances, the Panther radio-frequency signal is too powerful. For these situations, built in "attenuators" can be activated to reduce the signal level.

Berm - a long mound of earth raised above the normal ground level. When below grade burial is impractical, Panther sensor cables can be buried in a berm.

Boring Machine - a power-driven machine used to tunnel beneath paved surfaces. Where Panther sensor cables must cross a paved surface, such as a sidewalk, the cables can be passed through a hole bored beneath the surface.

Burial Medium - the soil, concrete, or asphalt in which the Panther sensor cables are buried. Ideally, each zone should be buried in only a single medium to simplify the adjustments that optimize the sensitivity.

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Bypass - a non-detecting section of a normally detecting zone. A section of non-detecting cable is spliced into the middle of the zone, producing a non-detecting area with no field strength. See field strength, non-detecting area.

Channel - the slot, trench, or tunnel that contains the sensor cable. This term is used to avoid repeating " the slot, trench, or tunnel".

Closed Loop - a perimeter which closes upon itself. Used to surround the valuables to be protected.

Centimeter (cm) - 1 centimeter = 0.3937 inches = 0.01 meters.

Covert - hidden and protected.

Decoupler - a device used for joining the ends of two zones together. It prevents the radio-frequency signals from the two zones interfering with each other while providing full strength overlapping coverage at the joint.

Detecting Section - the section of the sensor cables which emit and receive the radio-frequency signals. Note that the detecting section of the sensor cables does not have a uniform interior construction throughout its length.

Detection Field - the area in which an intruder will be detected. For Panther, the detection field exists primarily between the two sensor cables. However, it extends above and below ground as well as some distance to the outside of both cables. This results in a detection field with an oval cross-section.

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Detection Meter - an indicator of detection activity. The Panther detection unit has a detection meter on the front panel which allows adjustment of the sensitivity without any tools or equipment. It also provides visual confirmation of proper system operation.

Detection Range - see detection zone.

Detection Unit - the control panel which generates the detection signals, analyzes disturbances, and raises alarms when appropriate.

Discrimination - the ability to detect intruders while ignoring everything else. Panther can be set to detect intruders as light as 20 kg (44 lb), although the normal setting is based on a 70 kg (154 lb) intruder.

Disturbance - the affect of an intruder on the detection field. The size of the disturbance indicates the size of the intruder. Metallic objects, such as firearms, cause a large disturbance.

Dow Corning 888 - one brand of sealant which may be used when the sensor cables are placed into slots in pavement. See 3M Traffic Loop Sealant.

Electromagnetic Cross Section or ECS - a measure of the "detectability" of an object. Objects with a small ECS, such as wood or plastic, are not usually detected by Panther. Panther can easily detect objects with a large ECS, such as humans, automobiles, or other metallic or water filled objects.

EOL - "end of line". See supervision resistor, line supervision.

False Alarm - an alarm signal transmitted in the absence of an alarm condition.

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Ferrite Beads - small metallic "collars" that are slid onto the non-detecting lead-in cable during installation to stop the detection field. Without the beads, the detection field may stray along the lead-in towards the detection unit.

Field Start Section - the 4 m (13 ft) section of the sensor cables where the detection field builds up strength. This section of the cable is ported, and is situated between the non-detecting and detecting sections. These sections are always overlapped to compensate for the partial strength field. Intruders may or may not be detected in this area.

Field Strength - a measure of Panther sensitivity. The field strength varies along the length of the sensor cables. There is zero field strength on the non-detecting "lead-in" section. The field builds to full strength in the 4 m (13 ft) field start section of the cable, and stays at full strength to the end of the cable. At the cable end, there is either a decoupler or a terminator. In both cases, the field strength drops to zero about 4 m (13 ft) beyond the cable end. In some rare instances, a non-detecting section of cable is spliced into the middle of a (normally detecting) zone, producing a non-detecting area (or bypass) with no field strength.

Flooding - a sticky chemical coating designed to prevent the entry of water. The braided shield of each sensor cable is soaked with "flooding" during manufacture.

Foot (ft) - 1 foot = 0.3048 meters.

Inch (in) - 1 inch = 2.54 centimeters.

Intruder - a person entering or attempting to enter a secure area without authorization. Panther can be set to detect intruders as light as 20 kg (44 lb), although the normal setting is based on a 70 kg (154 lb) intruder.

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Irreparable Damage - a damaged section of sensor cable more than 3 m (9 ft, 9 in) in length.

Lead-in - the non-detecting section of the sensor cables which carries the signals from the detection unit to the detecting section of the sensor cables.

Leaky Cable - detecting cable. Detecting cable is called "leaky" because it allows rf energy to "leak" out and in.

Line Supervision - electronic protection of an alarm line, accomplished by sensing a continuous (coded) signal on the line. An intruder cutting or shorting out the line causes an alarm condition. This is often accomplished by using end-of-line (supervision resistors).

Load Set - a device attached to the unused zone in a single zone system. The load set prevents stray signals escaping from the detection unit.

Meter (m) - 1 meter = 3.2808 feet.

Medium - see burial medium.

Micro-processor - a solid-state, self-contained computer. Panther has a built in microprocessor that oversees all operations and decides whether a disturbance was caused by an intruder.

Minor Damage - a cut less than 1 cm (0.394 in) in length on a sensor cable jacket.

Moderate Damage - a damaged section less than 2.5 cm (1 in) in length on a sensor cable.

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Non-Detecting Area - a section of a zone where the detecting field is absent. In circumstances where a section of the perimeter must be non-detecting, a section of the detecting cable is removed, and an equal length of non-detecting cable is spliced in its place. The section removed from the detecting cable must be discarded. It must never be used for splicing, since its interior construction is non-uniform. See bypass.

Non-Detecting Section - the "lead-in" section of the sensor cables.

Nuisance Alarm - see false alarm.

Obstacle - an object that requires the re-routing of the sensor cables. Obstacles include metallic fences, lamp standards, trees, and so on. Some obstacles prevent the physical passage of the sensor cables while others can cause false alarms.

Open Loop - any configuration where the protected perimeter does not form a closed loop.

Overlapping Coverage - a method used to prevent weak spots in the detection field. The coverage provided by one zone does not abruptly stop at the cable end. In a two-zone decoupled system, the decouplers allow the zones to overlap at the ends without causing interference. The cable routing at the start of the two zones can also be arranged to provide overlapping coverage.

Overshoot - the detection field path at a sharp corner. If a sensor cable is routed around too sharp a turn, the detection field will "overshoot" or swing outwards at the curve. This does not cause a "weak spot", but it does mean that the field doen't follow the cable route as expected. This can cause false alarms if the overshoot encounters an obstacle which the cable route avoids.

Perimeter - the outside border of the site to be protected.

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PIR Detector - passive infrared detector. A type of detector that senses an intruder by detecting changes in the body heat of a human in the protected area.

Push Pipe - a length of steel pipe used to tunnel beneath paved surfaces. The pipe is driven through the soil with a sledge hammer and then withdrawn. See boring machine.

Return - a disturbance caused in the detection field that is measured by the detection unit. The microprocessor in the detection unit analyses the return to determine if it was caused by an intruder and requires an alarm.

Routing - the path followed by the buried sensor cables.

RXA, RXB - receive zone A, receive zone B.

Self-Amalagamating Tape - a type of tape that bonds to itself to form a waterproof layer. See 3M Insulation tape.

Sensitivity - a measure of the responsiveness of the system to a stimulus, such as an intrusion. If the sensitivity is set too high, small animals can trigger an alarm. If the sensitivity is set too low, human intruders may be able to cross the perimeter undetected. Sensitivity is set using the controls on the detection unit and a strip chart recorder.

Sensor Cables - Panther's buried intrusion sensing elements. A pair of cables are used. One cable transmits a radio-frequency signal, and the other receives it. The Panther microprocessor analyzes disturbances in the received signal to detect intruders. See non-detecting section, field start section, and detecting section.

Severe Damage - a damaged section more than 2.5 cm (1 in) but less than 3 m (9 ft, 9 in) in length on a sensor cable.

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Superficial Damage - a very small cut or scrape on the jacket of a sensor cable.

Supervision Resistors - line supervision terminating devices. These are typically used in contact closure type alarm systems to enable detection of wire cutting or short circuiting by intruders. Panther has a module built into the detection unit where supervision resistors can be easily installed if required. See line supervision.

Terminator - a device which provides the correct electrical characteristics at the end of the cable. The ends of all sensor cables must be equipped with terminators (or decouplers for a two-zone decoupled system).

3M Insulation Tape - 3M Scotchfill Electrical Insulation Putty (Tape)

3M Traffic Loop Sealant - one brand of sealant which may be used when the sensor cables are placed into slots in pavement. See Dow Corning 888.

TXA, TXB - transmit zone A, transmit zone B.

White Dot or White Mark - the mark on the sensor cable jacket that indicates the end of the non-detecting section and the start of the detecting section.

Zone - a section of the perimeter. Panther can monitor two separate sets of sensor cables and each one of these can be used to protect a different "zone". For systems requiring more than two zones, contact your Panther distributor.

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